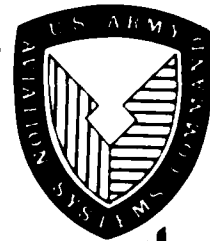


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PRELIMINARY AIRWORTHINESS EVALUATION OF THE UH - 1H HIND-D SURROGATE

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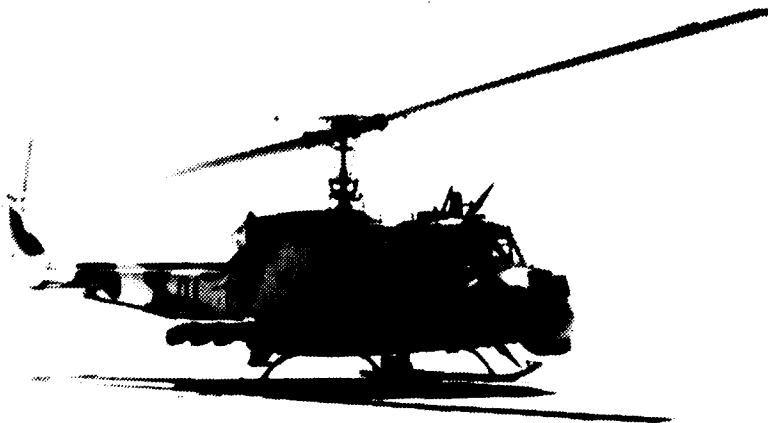
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FINAL REPORT

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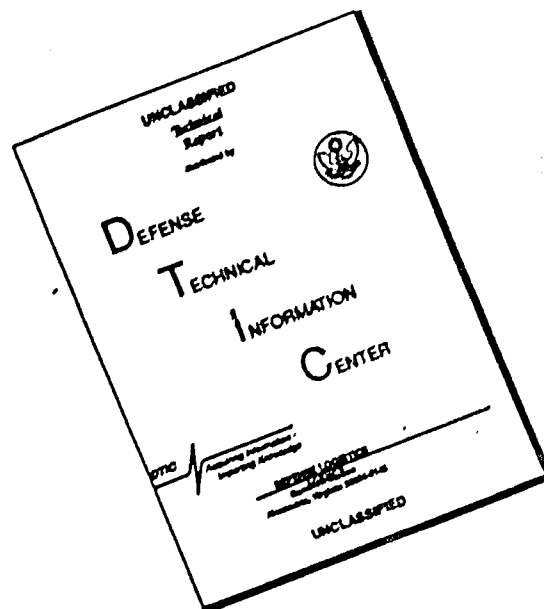


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Surrogate were not significantly different from the standard UH-1H helicopter. Two shortcomings were indentified: residual water collected in the bottom of the visual modification nose turret following exposure to rain, and debonding of the rubber pads located on the engine cowl near the upper aft detector belt attaching point.

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The US Army Aviation Engineering Flight Activity conducted a Preliminary Airworthiness Evaluation of the UH-1H/HIND-D Surrogate to determine if any significant handling qualities differences existed between the HIND-D Surrogate configured aircraft and the standard UH-1H helicopter. This evaluation was conducted at Edwards Air Force Base, California from 12 September to 3 October 1985. Fifteen flights were conducted for a total of 12.7 hours, of which 8.4 hours were productive. The handling qualities of the UH-1H/HIND-D | | |

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INTRODUCTION

BACKGROUND

1. The US Army Training and Doctrine Command tasked the Missile Command (MICOM) to develop a HIND-D simulation package for installation on the UH-1H helicopter. This system will be used at the National Training Center at Fort Irwin, California to add realism to the "Red versus Blue" training scenarios. The UH-1H helicopter was selected for this mission because of availability, not because of any performance or "look-alike" characteristics. LORAL Electro-Optical Systems (LEOS), Pasadena, California was contracted to design, develop and qualify the HIND-D package and to provide a Range Data Measurement System (RDMS) for the UH-1H. The contractor did not have a flight test capability; therefore, MICOM requested that flight evaluation of the installed system be accomplished by the US Army Aviation Systems Command (AVSCOM). AVSCOM directed the US Army Aviation Engineering Flight Activity (USAAEFA) to conduct a Preliminary Airworthiness Evaluation (PAE) of the UH-1H/HIND-D Surrogate (ref 1, app A). This evaluation was conducted in accordance with the approved test plan (ref 2).

TEST OBJECTIVE

2. The objective of this PAE was to conduct an evaluation of the UH-1H/HIND-D Surrogate handling qualities to determine if any significant differences exist between it and the standard UH-1H helicopter. The PAE was to also substantiate issuance of an airworthiness release for operational testing.

DESCRIPTION

3. The UH-1H/HIND-D Surrogate test aircraft was a standard production UH-1H helicopter US Army S/N 66-60928 manufactured by Bell Helicopter Textron with components of the UH-1H and AH-1 Air-to-Ground Engagement System installed. The aircraft is powered by an AVCO Lycoming T53-L-13B engine and features two-bladed metal, main and tail rotors. The HIND-D Surrogate package included the following external items which are depicted in photos 1 through 13, appendix B.

- a. M-156 hardpoint mounts.
- b. M-22 missile attachment and ballast weights.
- c. The Flash Weapon Effect Signal Simulator (FLASHWESS) and 30mm Cannon transmitter (LASER) mounted on the right side.

d. Launcher pod which includes a FLASHWESS and the 57mm Rocket transmitter (LASER) mounted on the left side.

e. Aircraft Kill Indicator (strobe and smoke) mounted on the left skid wheel attachment lugs.

f. Seven multiple Integrated Laser Engagement System detectors.

g. Visual modification mounted on the nose of the aircraft.

In addition, the following internal items were included:

a. AT-6 missile transmitter in gunner's sight (LASER).

b. Crew Kill Indicator (cockpit panel light).

c. Weapons Display/Weapons Select control panel.

d. RDMS mass mockup.

A second configuration was available which replaced the FLASHWESS on the right side with an Automatic Weapon Effect Signal Simulator. The 30mm cannon transmitter was retained.

4. A detailed description of the UH-1H is contained in reference 3, appendix A. A description of the UH-1H/HIND-D Surrogate external and internal configuration is contained in appendix B.

TEST SCOPE

5. Flight tests were conducted at Edwards Air Force Base (EAFB), California (elevation 2302 ft) between 12 September and 3 October 1985. The evaluation required 15 flights for a total of 12.7 hours, of which 8.4 hours were productive. The test aircraft was provided by US Army Forces Command. The contractor, LEOS, installed the HIND-D package at EAFB, and USAAEFA personnel maintained the test aircraft.

6. Flights were conducted at an engine start gross weight of 8500 pounds, density altitude of 7000 feet (except for low speed flight, slope landings and nap-of-the-earth flights), rotor speed of 324 rpm, and indicated airspeeds up to the never exceed airspeed. The requirements of MIL-H-8501A (ref 4, app A) were used as a guide. Flight restrictions and operating limitations were established by the operator's manual (ref 3) and an airworthiness release issued by AVSCOM (ref 5).

TEST METHODOLOGY

7. Flight test data were manually recorded utilizing standard aircraft instruments and measuring tapes for control positions. Established flight test techniques were used (ref 6, app A).

RESULTS AND DISCUSSION

GENERAL

8. A qualitative evaluation of the UH-1H/HIND-D Surrogate was performed to determine if any handling qualities differences exist between it and the standard UH-1H helicopter. Additional testing was to include a limited electromagnetic interference (EMI) test. A limited reliability and maintainability evaluation was also made. The handling qualities of the UH-1H/HIND-D Surrogate were not significantly different from the standard UH-1H helicopter. Two shortcomings were identified: residual water collected in the bottom of the visual modification (Vis Mod) nose turret following exposure to rain, and debonding of the rubber pads located on the engine cowl near the upper aft Multiple Integrated Laser Engagement System (MILES) detector belt attaching point. EMI tests were not completed due to a malfunction of the HIND-D Surrogate system.

HANDLING QUALITIES

General

9. The UH-1H/HIND-D Surrogate handling qualities were evaluated in the Flash Weapon Effect Signal Simulator (FLASHWESS) and the Automatic Weapon Effect Signal Simulator (AWESS) configurations, described in appendix B, and at the conditions specified in table 1.

Control Positions in Trimmed Forward Flight

10. Control positions in trimmed (ball-centered) forward flight were evaluated in level flight, military rated power (MRP) climbs, and autorotative descents. Data are presented in figure 1, appendix C. Increasing forward longitudinal control was required with increasing airspeed between 38 knots calibrated airspeed (KCAS) and 115 KCAS. Lateral control position varied less than 0.5 in. in forward flight. Adequate control margins existed throughout the conditions tested, and control positions were essentially the same as a standard UH-1H. The control positions of the UH-1H/HIND-D Surrogate in trimmed forward flight are satisfactory.

Static Longitudinal Stability

11. The static longitudinal stability characteristics were evaluated in trimmed level flight, MRP climbs, and autorotative descents. The collective was held fixed while airspeed was varied 20 knots about trim in 5-knot increments. Data are presented in figures 2 through 7, appendix C. The aircraft exhibited

Table 1. Handling Qualities Test Conditions¹

| Test | Average Gross Weight (lb) | Average Longitudinal Center of Gravity (FS) | Average Density Altitude (ft) | Calibrated Airspeed (kt) | Flight Condition |
|---------------------------------------|---------------------------|---|-------------------------------|---|-------------------|
| Airspeed Calibration | 7690 | 137.5 | 7020 | 34 - 112 | Level flight |
| Control Positions | 7690 | 137.5 | 7020 | 34 - 115 | Level flight |
| | | | | 60 and 80 | Climb and descent |
| Static Longitudinal Stability | 7520 | 138.5 | 7020 | 60 and 80 | Level flight |
| | | | | 60 and 80 ² | Climb and descent |
| Static Lateral-Directional Stability | 7520 | 137.5 | 7020 | 60 and 80 ³ | Level flight |
| | | | | 60 and 80 ² | Climb and descent |
| Maneuvering Stability | 7675 | 137.5 | 7020 | 60 and 80 | Level flight |
| Dynamic Longitudinal Stability | 7550 | 138.5 | 6880 | 60 and 80 | Level flight |
| Dynamic Lateral-Directional Stability | 7490 | 138.3 | 7000 | 60 | Level flight |
| Slope Landings ³ | 7500 | 138.0 | 2350 | -- | -- |
| Low Speed Flight | 7520 | 137.5 | 1980 | 0 - 35 ⁴ Forward, rearward, left and right sideward | -- |
| NOE Flight Profile | 7480 | 138.1 | 2200 | -- | -- |
| Simulated Sudden Engine Failure | 7520 | 137.5 | 7000 | 60 and 80 | -- |

NOTES:

¹Testing conducted in the FLASHWESS configuration unless otherwise noted.²Indicated airspeed³Testing repeated in the AWESS configuration.⁴True airspeed

positive static longitudinal stability characteristics as indicated by increasing forward longitudinal control with increasing airspeed about trim for all conditions tested. The static longitudinal stability characteristics of the UH-1H/HIND-D Surrogate are essentially the same as a standard UH-1H helicopter.

Static Lateral-Directional Stability

12. Static lateral-directional stability characteristics were evaluated in level flight, MRP climbs, and autorotation. The collective control was held fixed, and sideslip angle was varied by applying directional control (left and right) to move the trim ball to half, three quarters and one ball width from center while maintaining constant airspeed and heading. Data are presented in figures 8 through 16, appendix C. At all conditions tested, the aircraft exhibited positive directional stability characteristics as indicated by increased left directional control with increased right sideslip. Positive dihedral effect as indicated by increased right lateral control with increased right sideslip was also exhibited at all conditions in level flight and autorotation. In climb, the dihedral effect was slightly positive to neutral. The static lateral-directional stability characteristics of the UH-1H/HIND-D Surrogate are essentially the same as a standard UH-1H helicopter.

Maneuvering Stability

13. Maneuvering stability was evaluated in constant airspeed, ball-centered turns. Data are presented in figures 17 and 18, appendix C. The aircraft exhibited positive maneuvering stability as indicated by the variation of longitudinal control position and force with normal acceleration in that aft control movement and increasing aft force was required with increasing load factor. The helicopter attitude and load factor were easily controlled by the pilot. The maneuvering stability of the UH-1H/HIND-D Surrogate is essentially the same as a standard UH-1H helicopter.

Dynamic Stability

14. The longitudinal long-term dynamic stability was evaluated by displacing longitudinal cyclic from trim and increasing or decreasing indicated airspeed by 10 knots and then returning cyclic slowly to trim. All controls were then held fixed until recovery was initiated. The response to the off trim condition was essentially deadbeat with the aircraft returning to trim airspeed and attitude. The longitudinal long-term dynamic stability of the UH-1H/HIND-D Surrogate is essentially the same as a standard UH-1H helicopter.

15. The short-term longitudinal and lateral directional dynamic stability characteristics were evaluated by applying 1 inch, 1/2 second control pulses in each axis. The controls were then held fixed until the aircraft motion subsided. The aircraft longitudinal and lateral-directional response was essentially deadbeat. The UH-1H/HIND-D Surrogate short-term longitudinal and lateral-directional dynamic stability characteristics are essentially the same as a standard UH-1H helicopter.

Slope Landing Characteristics

16. The slope landing characteristics were evaluated by performing landings and takeoffs on a measured nonlevel surface. Tests were performed with both left and right skids upslope and surface winds of 5 knots or less. The slope was measured with an inclinometer on a metal bar placed on top of the aircraft skids after touchdown. Coordinated cyclic, collective, and directional control inputs were required until the helicopter was firmly positioned on the slope. Slope takeoffs and landings were easily performed up to approximately 8 deg left and right with adequate safe ground clearance on all wing stores as shown in photo 1, appendix D. The minimum ground clearance with the aircraft on a level surface is 11.25 inches for the right wing store of the AWESS configuration. The slope landing characteristics of the UH-1H/HIND-D Surrogate are essentially the same as the standard UH-1H helicopter and are satisfactory. A comment should be added to the operator's manual for the UH-1H/HIND-D Surrogate stating that special attention will be required when landing to unprepared areas to insure adequate wing store to ground clearance.

Low Speed Flight Characteristics

17. Low speed flight characteristics were evaluated at 10 ft skid height using a calibrated ground pace vehicle as the airspeed reference. Tests were performed in winds of 5 knots or less. Data are presented in figures 19 and 20, appendix C. During steady low speed flight, adequate control margins (at least 10%) remained in all axes except for directional control at a relative wind azimuth of 090 degrees between 5 knots true airspeed (KTAS) and 30 KTAS. The directional control remaining for the 090 degree relative azimuth is consistent with information presented in the operator's manual (ref 2, app A). The low speed flight characteristics of the UH-1H/HIND-D Surrogate are essentially the same as the standard UH-1H helicopter.

Nap-of-the-Earth Flight Maneuvers

18. Nap-of-the-earth (NOE) flight characteristics were evaluated by performing level acceleration, quick stops, side flares, and

masking/unmasking maneuvers. All maneuvers were easily performed and no unusual aircraft handling qualities were noted. The NOE flight characteristics of the UH-1H/HIND-D Surrogate are essentially the same as the standard UH-1H helicopter.

Simulated Sudden Engine Failures

19. Simulated sudden engine failures were evaluated from level flight and MRP climbs. The aircraft was stabilized at a trim condition and the throttle was rapidly reduced to flight idle. Following throttle reduction, the controls were held fixed until pilot corrective action was required. Main rotor speed was the determining factor in initiating corrective action. Collective control reduction was required within 1.5 to 2.0 seconds to prevent rotor speed from going below 294 rpm. The engine failure condition was easily identified in that the aircraft yawed and rolled left immediately following throttle reduction. The low rotor speed warning light and audio tone activated approximately one second after throttle reduction. Minimum control inputs were required to recover the aircraft and establish steady state autorotation at 80 KIAS. No unusual aircraft handling qualities were noted during the test. The simulated sudden engine failure characteristics of the UH-1H/HIND-D Surrogate are essentially the same as a standard UH-1H.

MAINTAINABILITY AND RELIABILITY

General

20. The reliability and maintainability of external equipment mounted on the UH-1H/HIND-D Surrogate were evaluated throughout the test. Several potential problem areas were identified. Prior to each flight all external equipment should be inspected with particular attention to attaching points for security and cracks and to MILES detector belts for tension and abrasion on the fuselage/tailboom skin.

Detector Belts

21. Abrasions were noted on the aircraft aft lower left fuselage and left side tailboom underneath the metal buckles of the MILES detector belts (photo 2, app D). Some padding is already attached to the back side of the buckles. However, after only 12.7 hours of flight, the abrasion areas are visible and will eventually require sheet metal repair to the aircraft skin. Additional padding material should be attached to the aircraft skin beneath the MILES detector belt buckles.

22. The forward half of the MILES detector belt mounted on the right side tailboom sagged away from the tailboom surface. Tightening the belt did not correct this problem. Additional velcro fasteners should be installed on the forward half of the tailboom MILES detector belts.

Hardware

23. A 0.75 inch diameter stainless steel coarse thread bolt was damaged during ground maintenance. This bolt was used to attach a bracket (Serial No. 10200-11749127XA) at the aft end of the FLASHWESS pod (FLASHWESS configuration) and to attach the AWESS assembly to the rack adapter (AWESS configuration) as shown in photo 3, appendix D. The use of coarse thread, stainless steel bolts will increase potential for damage when hardware is removed and reinstalled. All coarse thread, stainless steel bolts should be replaced with aircraft quality fine thread bolts appropriate for the design structural loads.

Relocation of Search Light Limit Switch

24. During the initial inspection of the HIND-D Surrogate, it was noted that the search light, when positioned forward, could come in contact with and melt the Vis Mod. To correct this problem, a minor modification was made to the Vis Mod to allow removal of the search light and another to limit the forward travel of the light to approximately 90 degrees. These allow the search light to be extended down to about perpendicular to the ground during hover and provides adequate clearance with the Vis Mod. These modifications should be made to all UH-1H/HIND-D aircraft and can be made as follows. Drill two 1/2 inch holes in the Vis Mod (photo 4, app D). This will permit access to the two forward search light mount screws and allow removal of the search light for relocation of the limit switch and later replacement of the light bulb when required. Prior to removing the search light, extend the light full down. Then refer to photo 5 and proceed as follows:

- a. Remove search light.
- b. Remove gear cover.
- c. By manually moving gears, slew the search light fully extended until clearance will allow drilling out of the last (toward light bulb) limit switch hole.
- d. Drill out this hole with a #33 drill bit.

e. Install a 4-40 screw (MS 35206-216) and nut (MD 21042-L04), with screwhead toward gear cover.

f. Reinstall the search light.

g. Check operation of light and insure clearance of the VIS Mod while extending the light full down, and slewing 180 degrees left and right.

Vis Mod Drain Holes

25. Residual water collected in the lower portion of the Vis Mod nose assembly when the aircraft was exposed to rain. There were no provisions for this residual water to drain. The lack of drain holes in the lower portion of the Vis Mod nose assembly is a shortcoming. Drain holes should be placed in the lower portion of the Vis Mod nose assembly to allow residual water to drain.

Wear Strip Debonding

26. A rubber wear strip attached to the left engine cowl at the upper aft MILES detector belt attaching point (photo 6, app D) debonded and separated from the aircraft during one flight. Post flight inspection revealed that an identical rubber wear strip on the right engine cowl was beginning to debond. The debonding of the rubber wear strips attached to the engine cowl at the upper aft MILES detector belt attaching points is a shortcoming. A different bonding material and/or a different type of wear strip should be used at the upper aft MILES detector belt attachment points.

AIRCRAFT PITOT-STATIC SYSTEM

27. The aircraft pitot-static system was calibrated by using the trailing bomb method to determine the airspeed position error, presented in figure 21, appendix C. The pilot and copilot airspeed indicators were calibrated prior to flight test. The position error presented in figure 21 should be used for UH-1H/HIND-D Surrogate aircraft.

CONCLUSIONS

GENERAL

28. The handling qualities of the UH-1H/HIND-D Surrogate were not significantly different from the standard UH-1H helicopter. Two shortcomings were identified.

SHORTCOMINGS

29. The following shortcomings were identified:

a. Lack of drain holes in the lower portion of the visual modification nose assembly (para 25).

b. The debonding of the rubber wear strips attached to the engine cowl at the upper aft MILES detector belt attaching points (para 26).

RECOMMENDATIONS

30. The following recommendations are made:

a. A comment should be added to the operator's manual for the UH-1H/HIND-D Surrogate stating that special attention will be required when landing to unprepared areas to insure adequate wing store ground clearance (para 16).

b. Prior to each flight, all external equipment should be inspected with particular attention to attaching points for security and cracks and to MILES detector belts for tension and abrasion on the fuselage/tailboom skin (para 20).

c. Additional padding material should be attached to the aircraft skin beneath the MILES detector belt buckles (para 21).

d. Additional velcro fasteners should be installed on the forward half of the tailboom MILES detector belts (para 22).

e. All coarse thread, stainless steel bolts should be replaced with aircraft quality fine thread bolts appropriate for the design structural loads (para 23).

f. Modifications to the nose mounted visual modification and to the search light should be made to all UH-1H/HIND-D Surrogate aircraft to prevent possible contact and subsequent damage (para 24).

g. Drain holes should be placed in the lower portion of the visual modification nose assembly to allow residual water to drain (para 25).

h. A different bonding material and/or a different type of wear strip should be used at the upper aft MILES detector belt attachment points (para 26).

i. The airspeed position error presented in figure 21 should be used for the UH-1H/HIND-D Surrogate aircraft (para 27).

APPENDIX A. REFERENCES

1. Letter, AVSCOM, DRSAB-ED, 6 July 1984, subject: Preliminary Airworthiness Evaluation of the UH-1M/HIND-D Surrogate. (Test Request)
2. Test Plan, USAAEFA Project No. 84-14, *Preliminary Airworthiness Evaluation of the UH-1H/HIND-D Surrogate*, August 1984.
3. Technical Manual, TM 55-1520-210-10, *Operator's Manual, Army Model UH-1H Helicopter*, 15 July 1985.
4. Military Specification, MIL-H-8501A, *Helicopter Flying and Ground Handling Qualities; General Requirements for*, 7 September 1961 with amendment 1, 3 April 1962.
5. Letter, AVSCOM, AMSAB-E, 31 January 1985, subject: Airworthiness Release for UH-1H Helicopter Configured as "HIND-D" Surrogate by Loral Electro-Optical Systems (LEOS), with revision dated 13 September 1985.
6. Flight Test Manual, Naval Air Test Center, FTM No. 101, *Helicopter Stability and Control*, 10 June 1968.

APPENDIX B. DESCRIPTION

GENERAL

1. The UH-1H/HIND-D Surrogate consisted of a modified UH-1H helicopter equipped with the M-22 SS-11 missile system mounts and five nonstandard external stores. Additionally, modified missile launchers were used as ballast weights on the missile system mounts to change the natural frequency of the system. Internal equipment included a retractable M5 missile sight incorporating a LASER transmitter at the copilot station, a retractable rocket/cannon sight at the pilot station, a Crew Kill Indicator mounted on the center windscreen divider, and a dummy range data measuring system (RDMS) mounted in the cargo compartment. A weapons select/weapons display control panel mounted in the forward left portion of the center console was designed to allow selection of the weapon to be fired and a digital display of rounds of ammunition remaining. Two external configurations of the UH-1H/HIND-D Surrogate were evaluated.

FLASH WEAPON EFFECT SIGNAL SIMULATOR CONFIGURATION

2. The Flash Weapon Effect Signal Simulator (FLASHWESS) configuration was the primary configuration evaluated. This configuration is shown in photos 1 through 6 and included the external equipment described below.

a. A FLASHWESS was mounted on the right wing store as shown in photos 1 and 7. A cannon transmitter (LASER) was mounted on the bottom of the FLASHWESS. The fixed cannon transmitter was sighted from the pilot station and when fired the system was designed to activate the FLASHWESS (light) and a laser signal from the cannon transmitter to simulate the 30mm cannon fire.

b. The launcher pod, shown in photos 1 and 8, incorporated a FLASHWESS and rocket transmitter and was mounted on the left wing store. The rocket system was sighted from the pilot station and when fired, the system was designed to activate the FLASHWESS (light) and a laser signal from the rocket transmitter simulating the 57mm rockets employed on the HIND-D helicopter.

c. The AT-6 missile transmitter and sight was mounted at the copilot's station. When the AT-6 missile system was fired, a laser signal from the missile transmitter and the FLASHWESS in the launcher pod (photo 8) were designed to activate.

d. Seven Multiple Integrated Laser Engagement System (MILES) detector belts were mounted on the fuselage as shown in photos 1 through 6. When the detector belts are exposed to laser emissions

resulting from simulated air/ground weapons fire directed at the aircraft, the smoke and Automatic Kill Indicator (AKI) module described in paragraph 2e is designed to be activated.

e. The smoke and AKI module was mounted on the left skid at the ground handling wheel mounting point as shown in photos 1, 9 and 10. The smoke generator and strobe beacon are designed to activate when one or more of the detector belts is exposed to laser emissions from simulated air/ground weapons fire.

f. Additional external equipment included the RDMS and antenna mount (photos 6 and 11) mounted on the cabin roof, the nose mounted visual modification (VIS Mod) shown in photos 1, 2, 6 and 12, and the four ballast weights shown in photo 1.

AUTOMATIC WEAPON EFFECT SIGNAL SIMULATOR

3. The Automatic Weapon Effect Signal Simulator (AWESS) configuration was the secondary configuration evaluated. The external and internal AWESS configuration was identical to the FLASHWESS configuration except for the following changes.

a. The FLASHWESS assembly described in paragraph 2a was removed from the right wing store and replaced with the AWESS assembly shown in photo 13. The cannon transmitter was mounted on the bottom side of the AWESS.

b. Additionally, the three ballast weights on the right wing store of the FLASHWESS configuration were removed (photo 13).

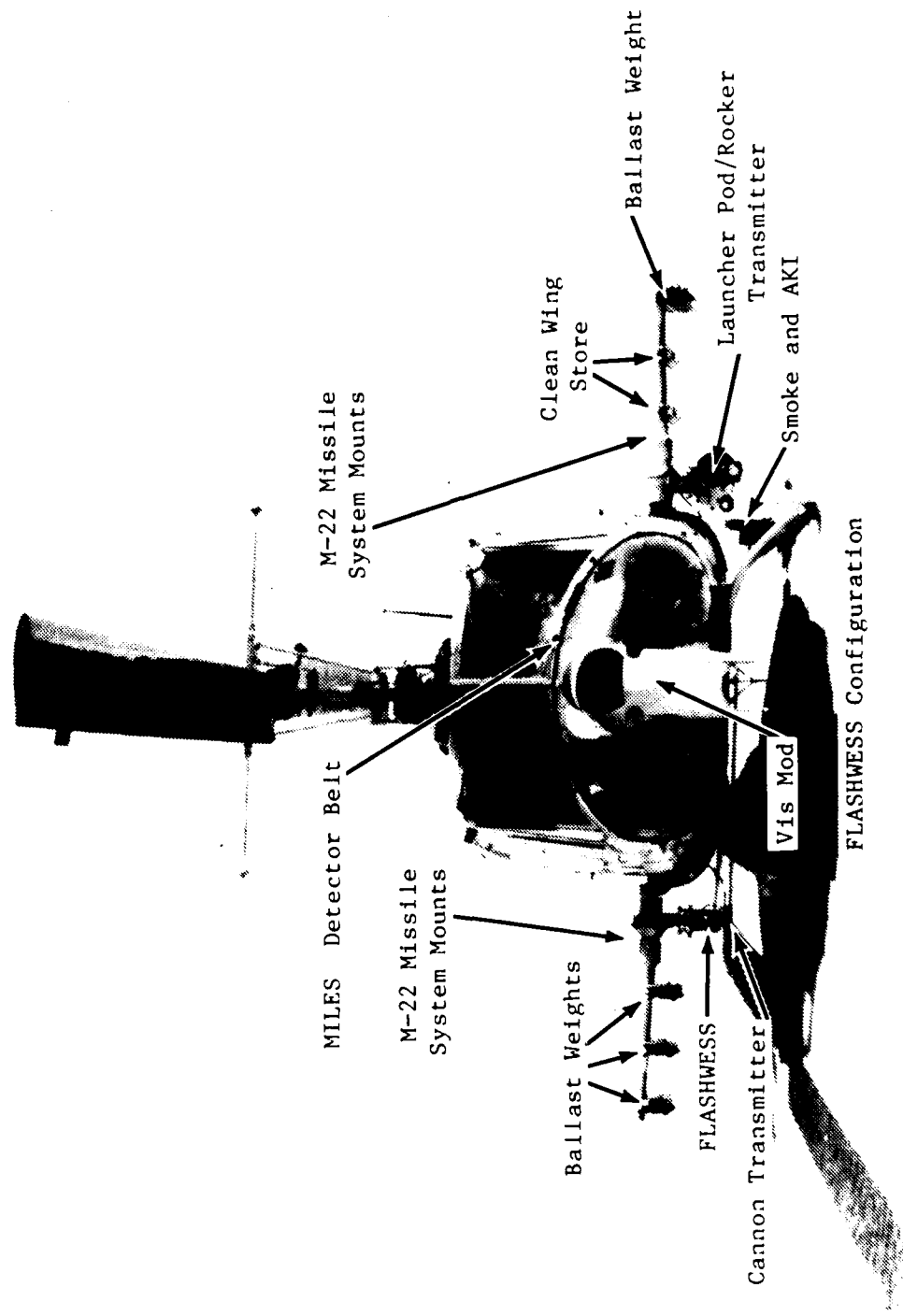


Photo 1. UH-1H/HIND-D Surrogate, Front View

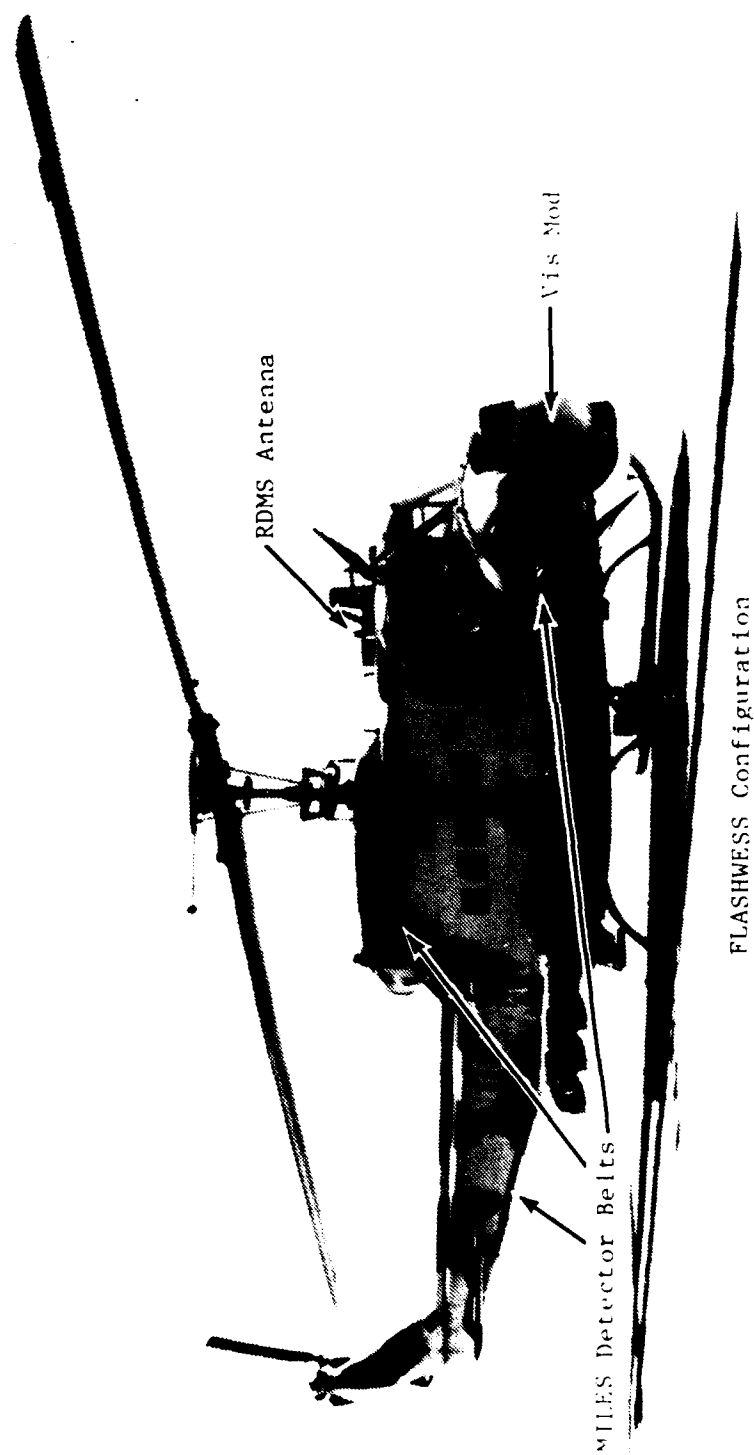
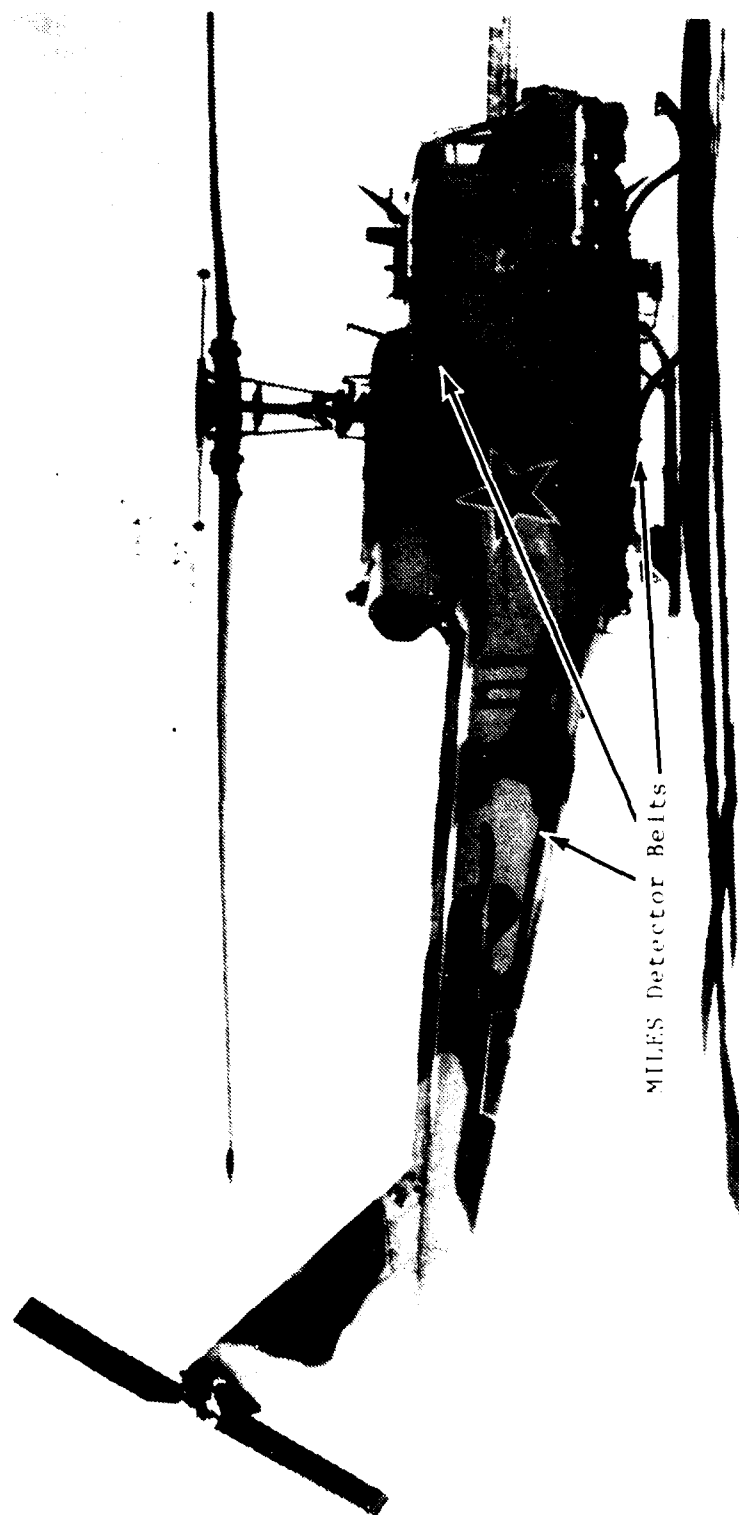


Photo 2. UH-1H/HIND-D Surrogate - Right Front Quartering View



FLASHWESS Configuration

Photo 3. UH-1H/HIND-D Surrogate - Right Rear Quartering View

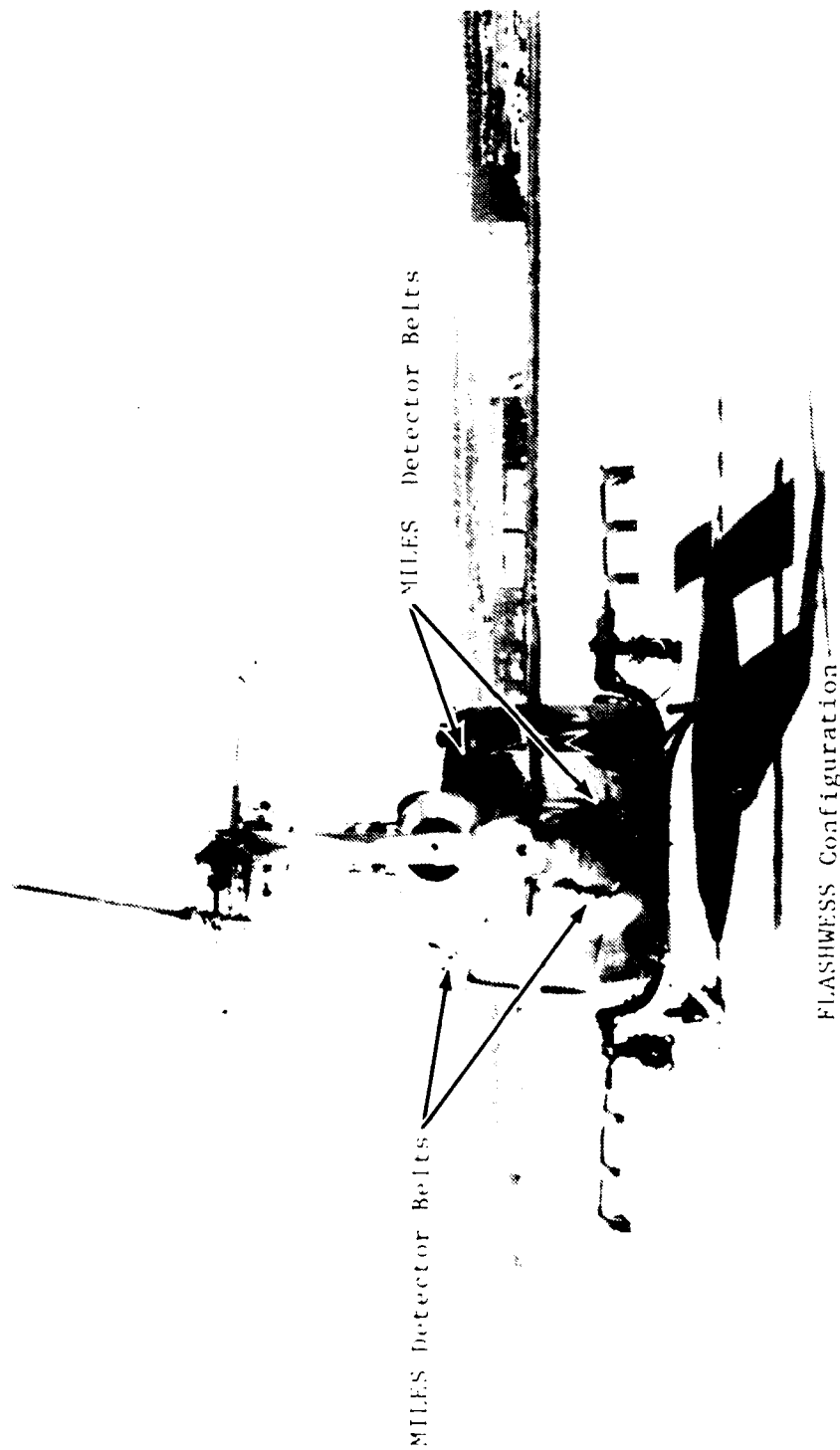
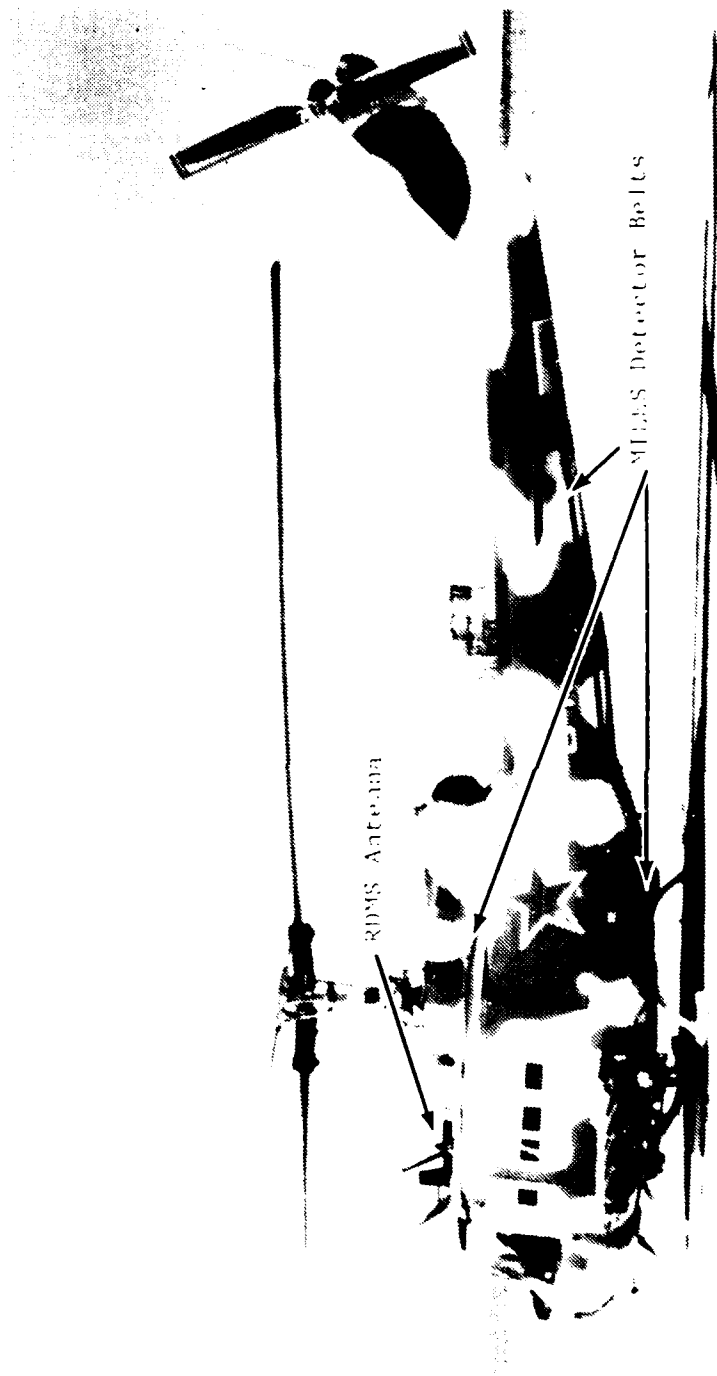
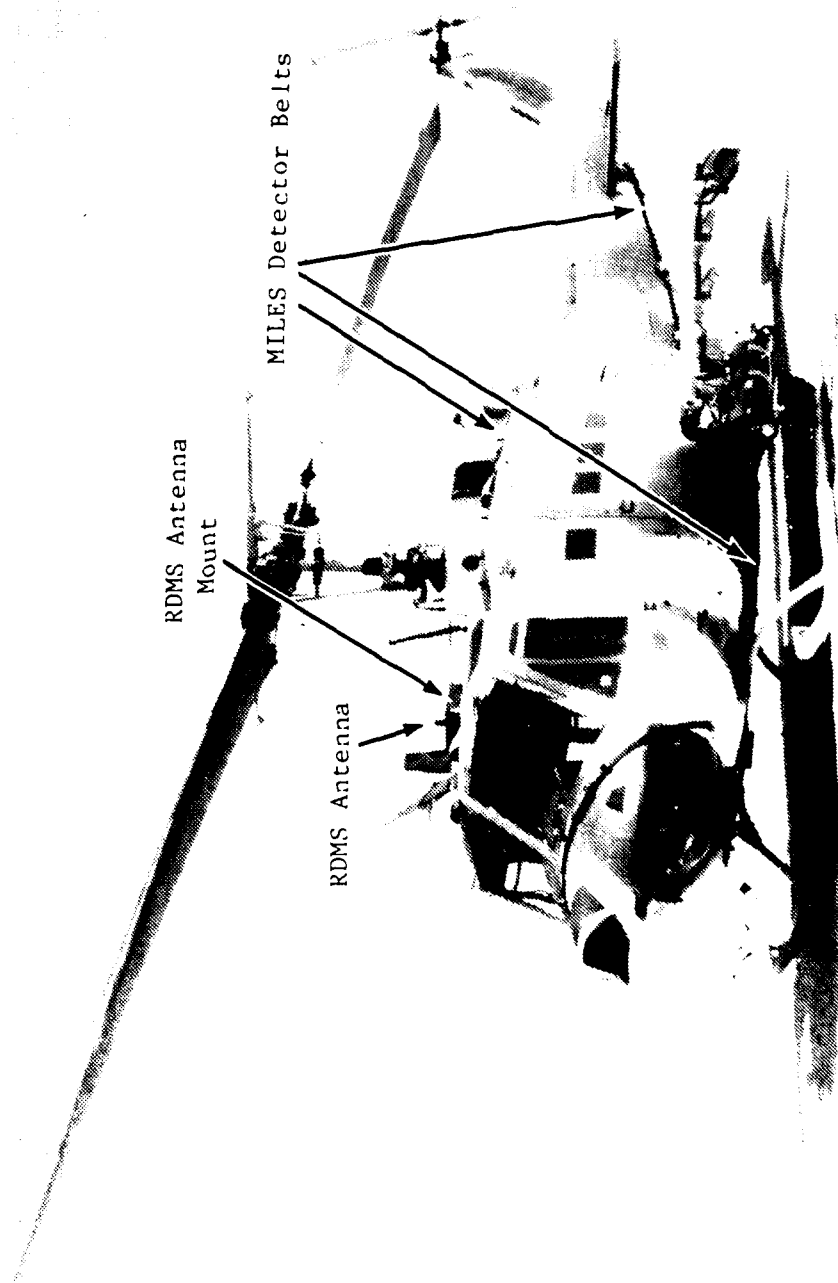


Photo 4. IH-1H/HIND-D Surrogate - Rear View



FLASHER Configuration

Photo 5. UH-1H/HND-D Surrogate - Left Rear Quartering View

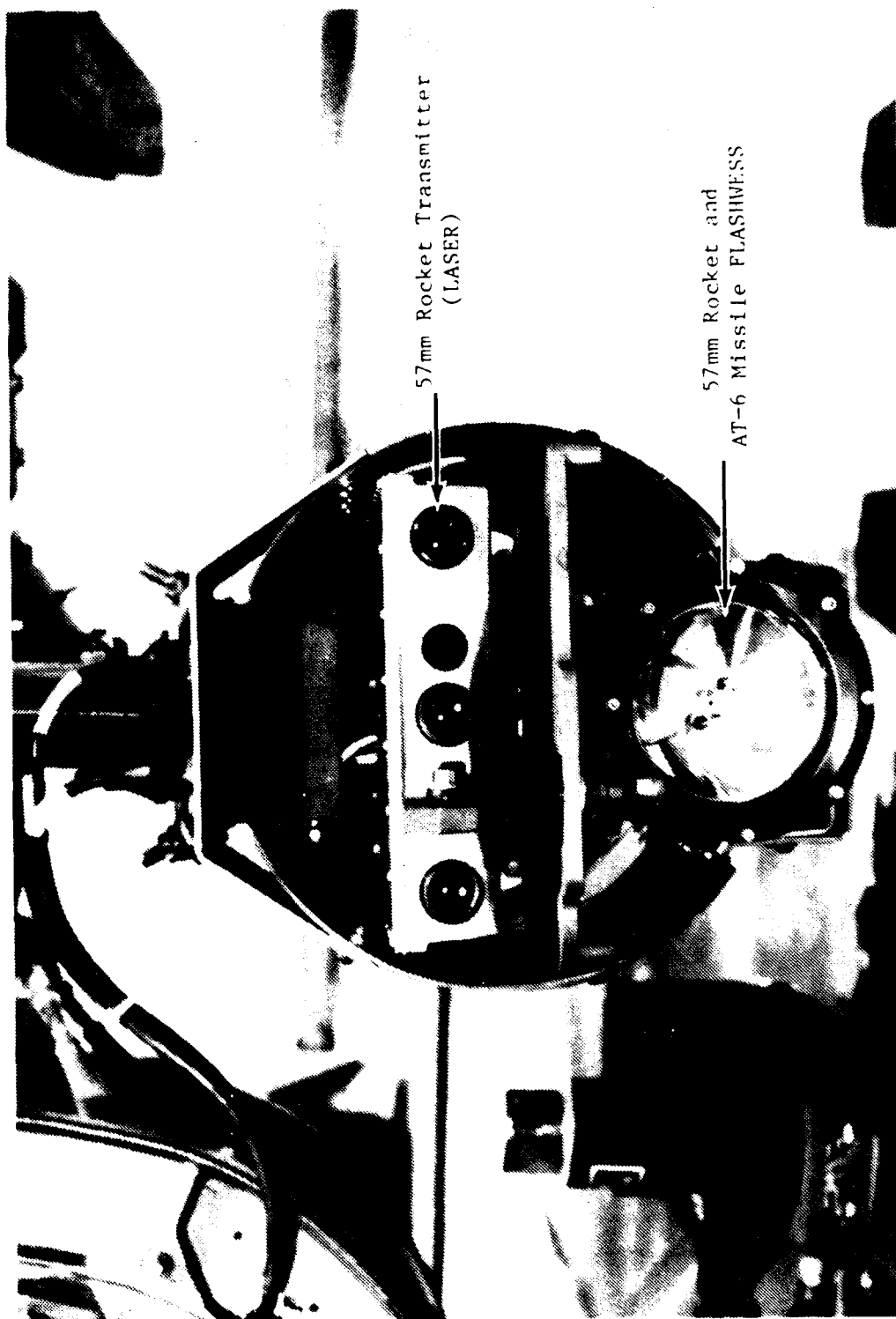


FLASHWESS Configuration

Photo 6. UH-1H/HIND-D Surrogate - Left Front Quartering View



Photo 7. FLASHWESS and Cannon Transmitter - Right Wing Store



57mm Rocket Transmitter
(LASER)

57mm Rocket and
AT-6 Missile FLASHWESS

Photo 8. Launcher Pod - Left Wing Store

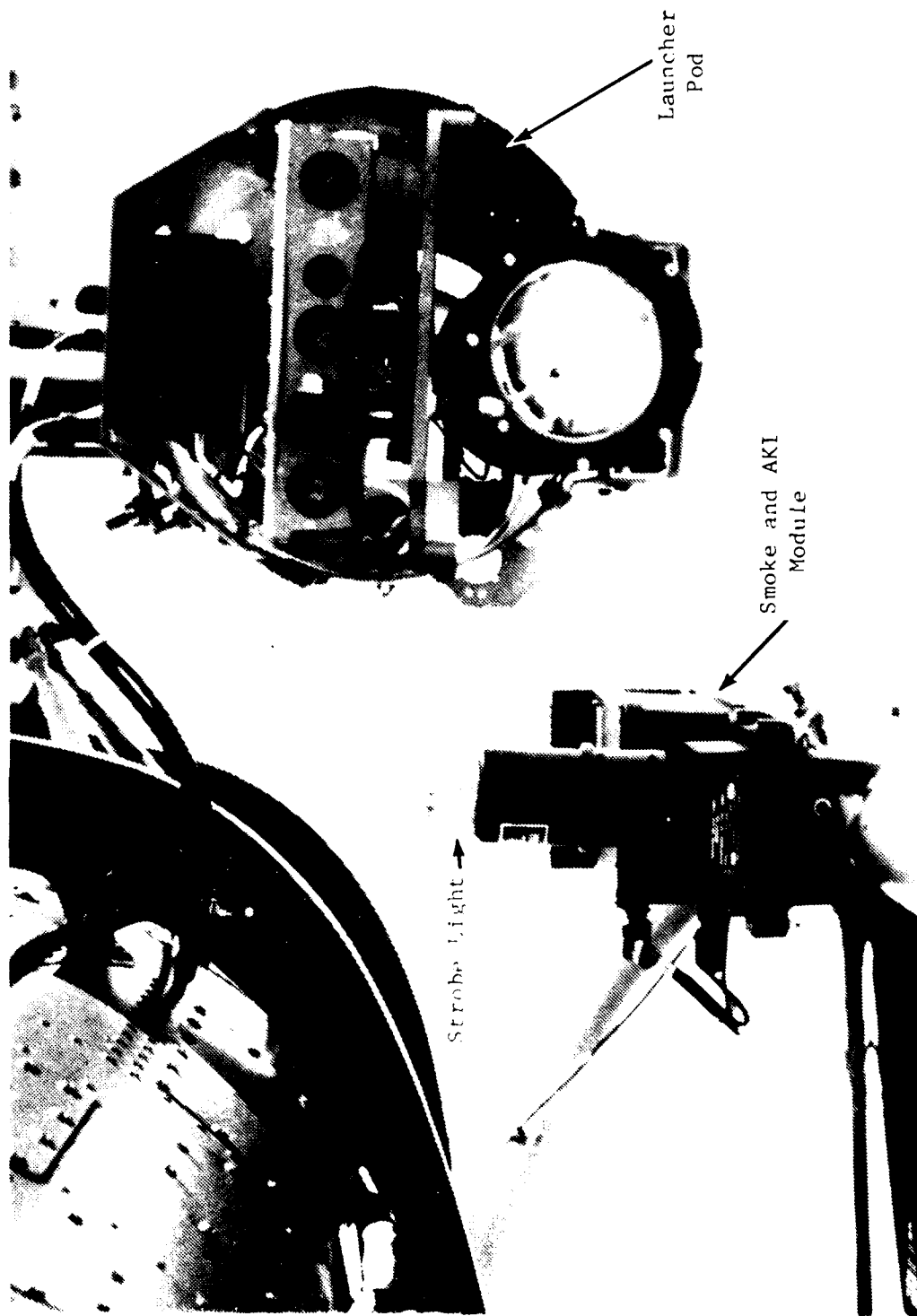


Photo 9. UH-1H/HIND-D Surrogate - Lower Left Side

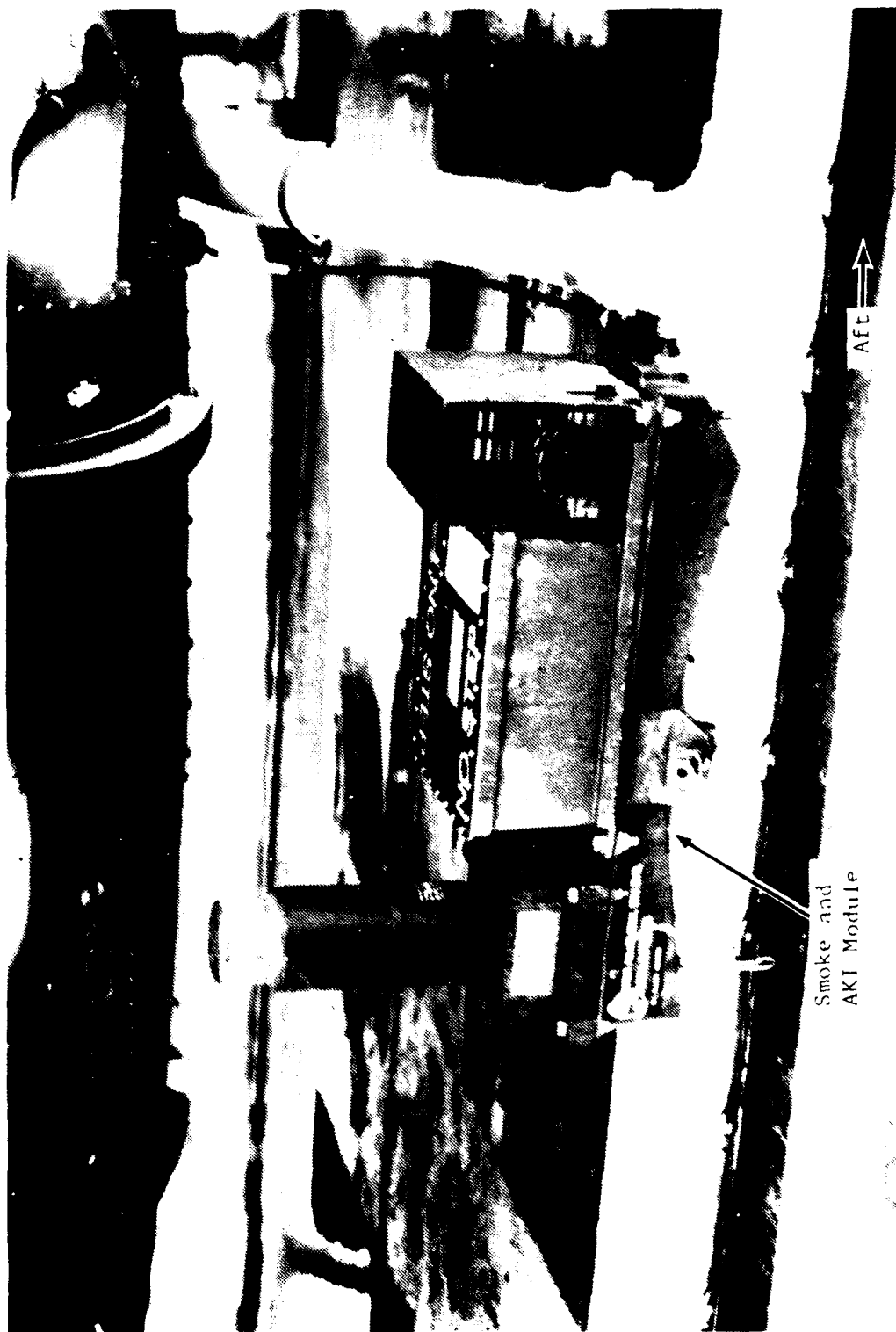


Photo 10. UH-1H/HIND-D Surrogate - Lower Left Side

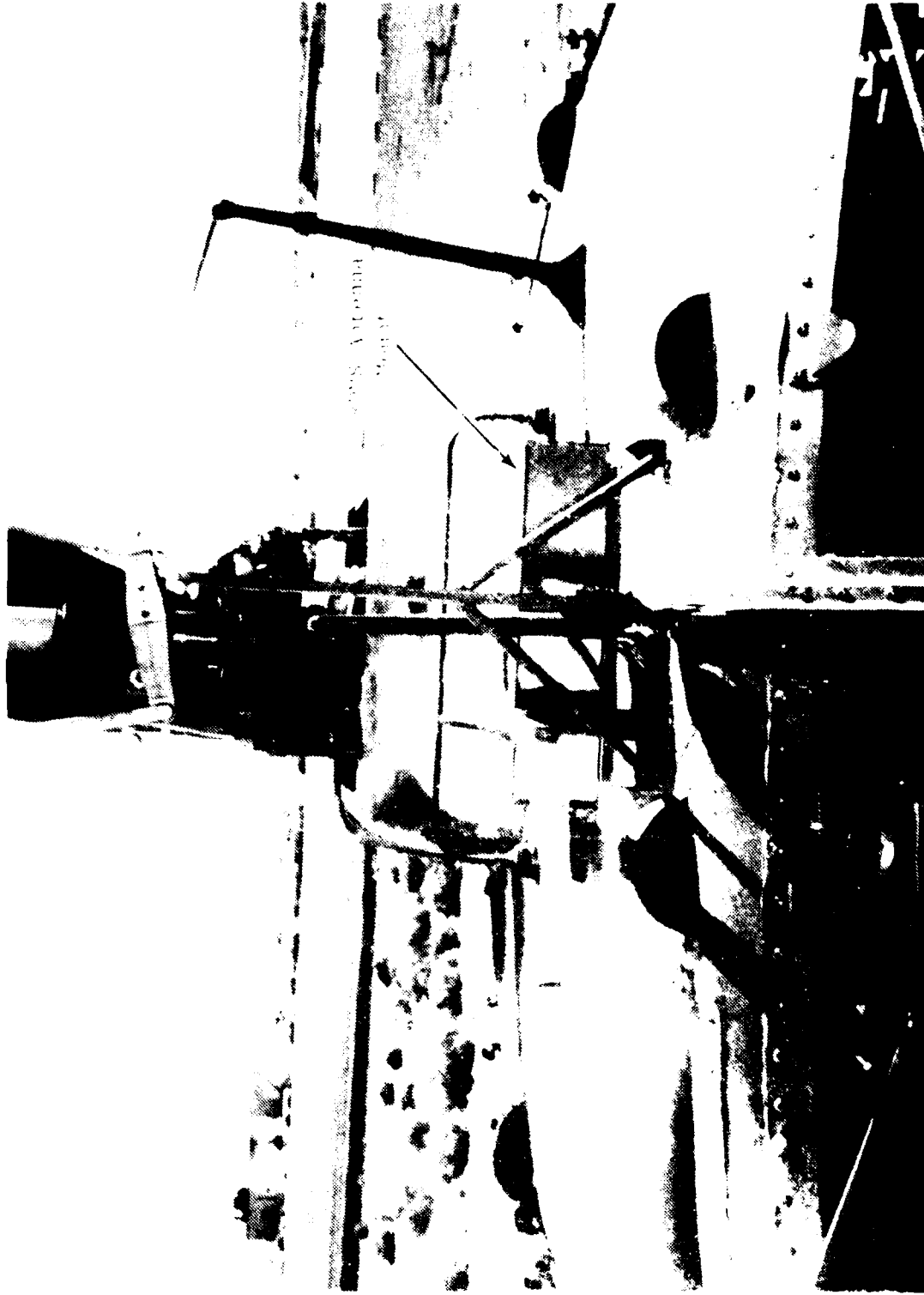


Photo 11. EH-1H/HUH-1D Surrogate - Upper Front View



Photo 17. Vis Mod



Photo 13. UH-1H/HIND-D Surrogate - Right Wing Store

APPENDIX C. TEST DATA

INDEX

| <u>Figure</u> | <u>Figure Number</u> |
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| Control Positions in Trimmed Forward Flight | 1 |
| Static Longitudinal Stability | 2 through 7 |
| Static Lateral Directional Stability | 8 through 16 |
| Maneuvering Stability | 17 through 18 |
| Low Speed Flight Characteristics | 19 through 20 |
| Airspeed Calibration | 21 |

FIGURE 1
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
UH-1H/HIND SURROGATE USA S/N 56-62928

| SYMBOL | AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSS) | AVG DENSITY ALTITUDE (FEET) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|--------|------------------------|------------------------------------|-----------------------------|-----------------|-----------------------|-----------------------|
| □ | 7770 | 138.5 (MID) | 7010 | 12.0 | 324 | LEVEL |
| ⊙ | 7440 | 136.8 (MID) | 4400 | 13.0 | 324 | LEVEL |
| * | 7610 | 137.5 (MID) | 7010 | 12.0 | 324 | CLIMB |
| Δ | 7610 | 137.5 (MID) | 7010 | 12.0 | 324 | AUTO |

NOTES: 1. BALL CENTERED FLIGHT
2. FLASHWESS CONFIGURATION

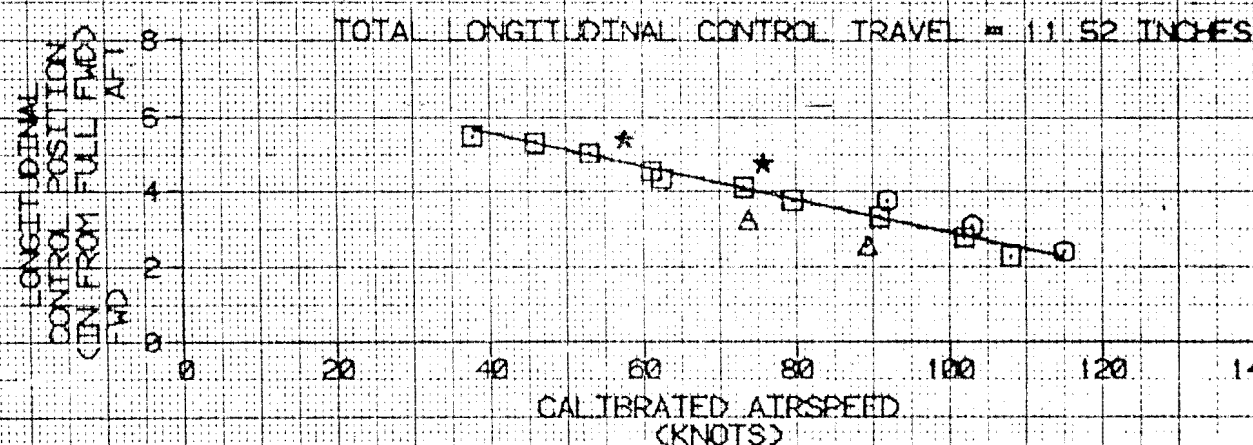
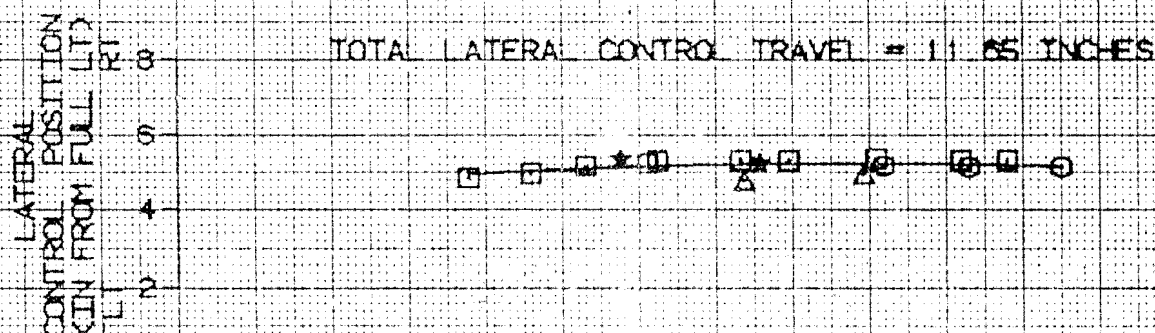
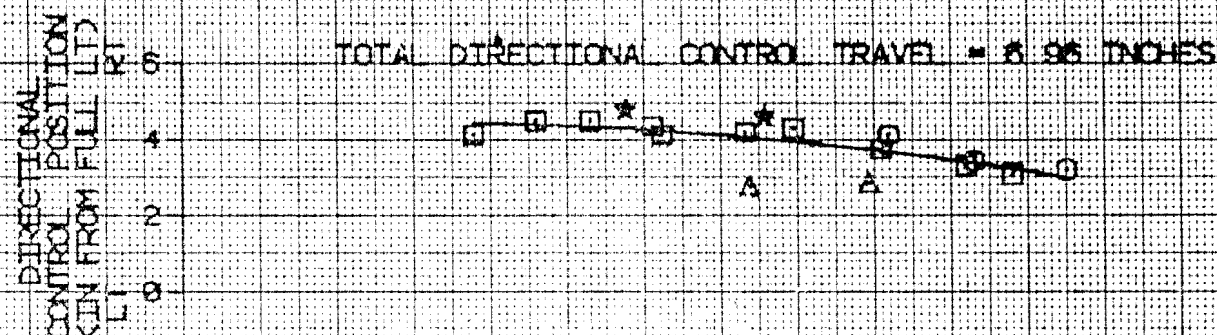


FIGURE 2

STATIC LONGITUDINAL STABILITY

UH-1H/MINO SURROGATE USA S/N 68-50928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FUS) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|---------------------------------|---|------------------------------------|-----------------------|--------------------------------|-----------------------------|
| 7520 | 137.5 (MTD) | 7220 | 13.0 | 324 | LEVEL |

- NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. FLASHLESS CONFIGURATION

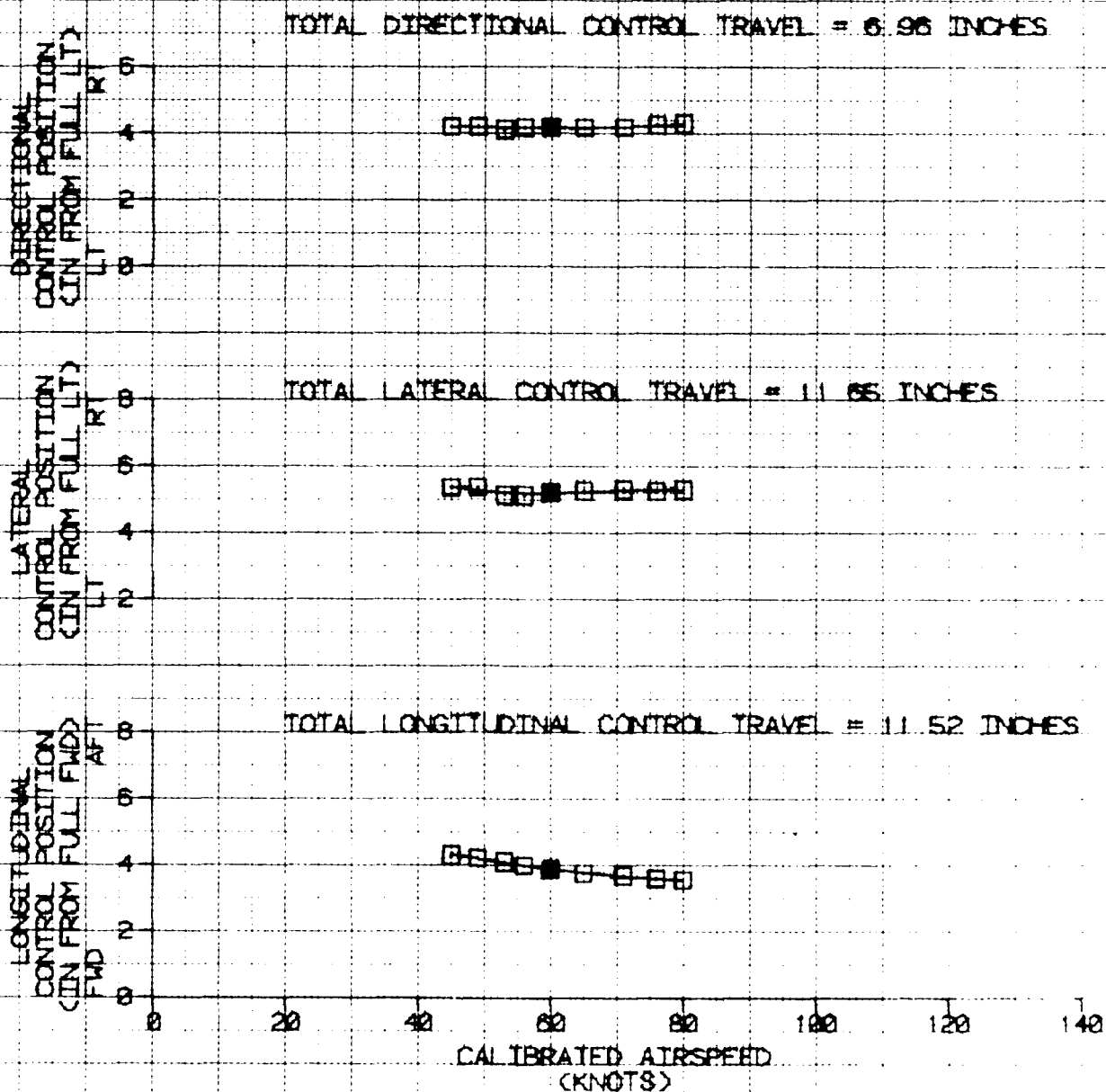


FIGURE 3
STATIC LONGITUDINAL STABILITY
UH-1H/HIND SURROGATE USA S/N 65-60928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL DENSITY OF LOCATION (FS) | AVG ALTITUDE (FT) | AVG QAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|---------------------------------|--|-------------------------|-----------------------|--------------------------------|-----------------------------|
| 7520 | 137.5 (MID) | 7020 | 13.0 | 324 | LEVEL |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. FLASHWESS CONFIGURATION

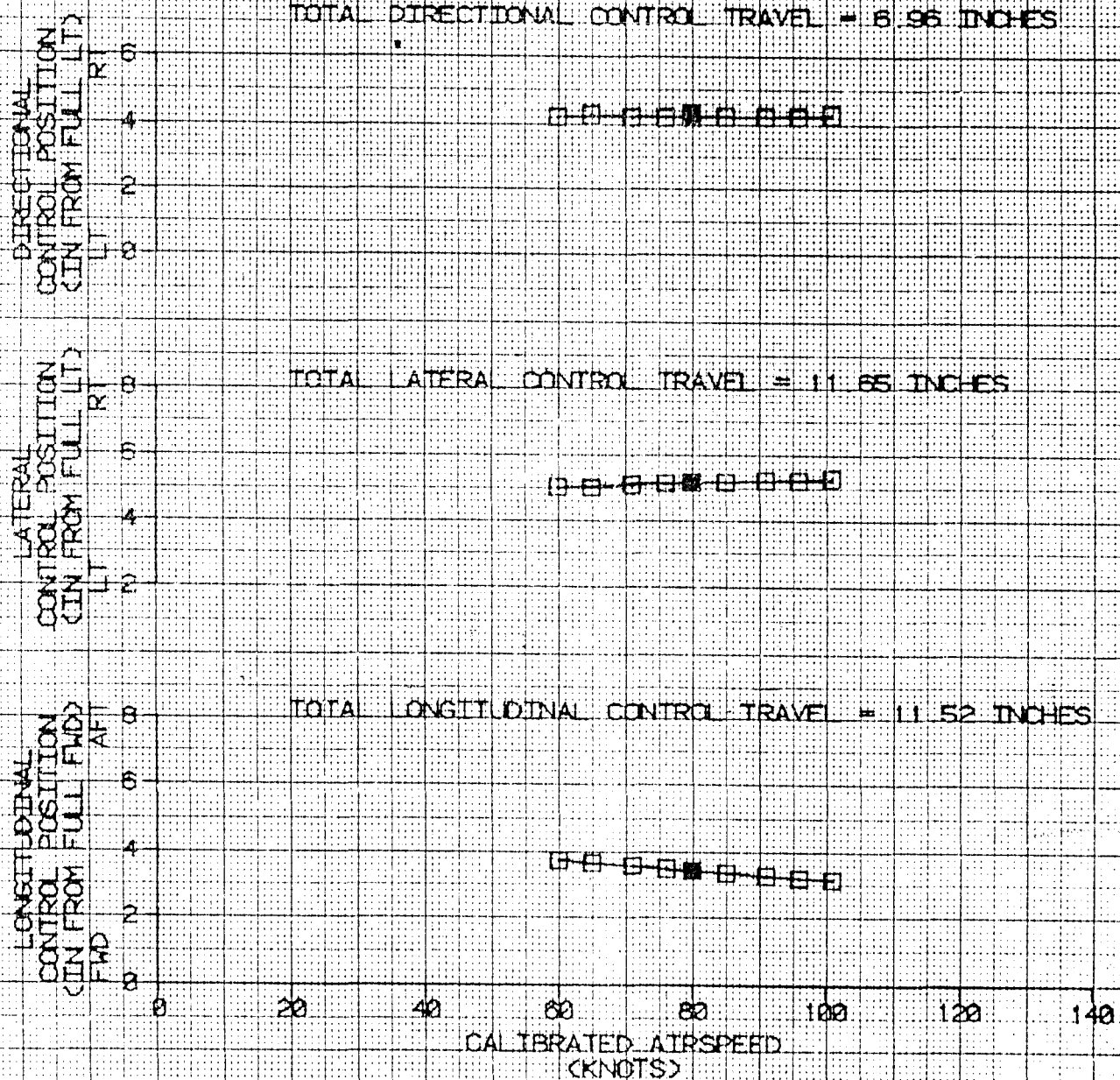


FIGURE 4

STATIC LONGITUDINAL STABILITY

UH-1H/HIND SURROGATE USA S/N 66-80928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (F/S) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|--------------------------------|---|------------------------------------|-----------------------|--------------------------------|-----------------------------|
| 7520 | 137.5 (MID) | 7020 | 13.0 | 324 | CLIMB |

- NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. FLASHWEISS CONFIGURATION

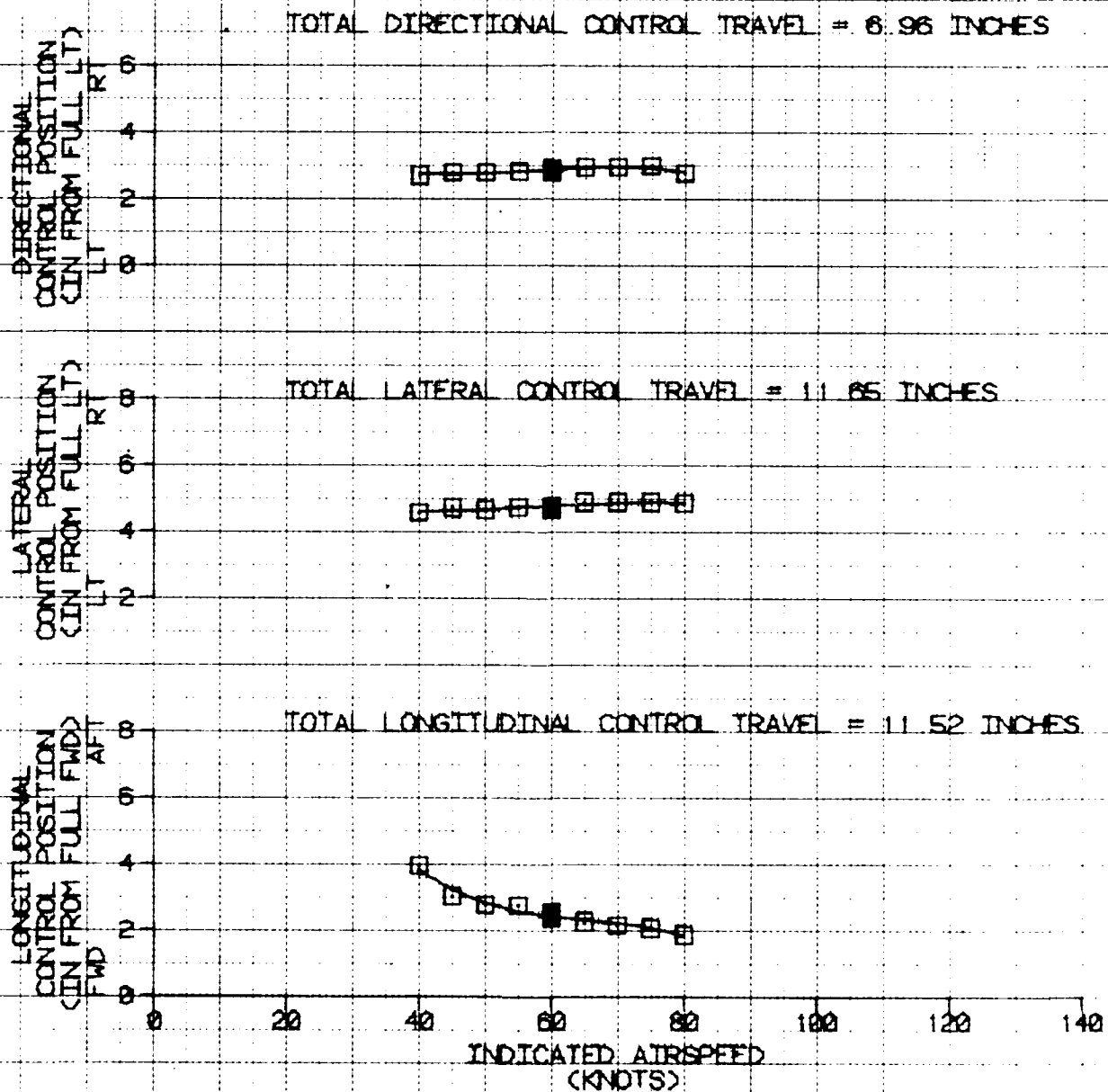


FIGURE 5
 STATIC LONGITUDINAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 66-60628

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FS) | AVG DENSITY ALTITUDE (FT) | AVG QAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|--------------------------------|--|------------------------------------|-----------------------|--------------------------------|-----------------------------|
| 7522 | 137.5 (MID) | 7220 | 13.0 | 324 | CLIMB |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHWESS CONFIGURATION

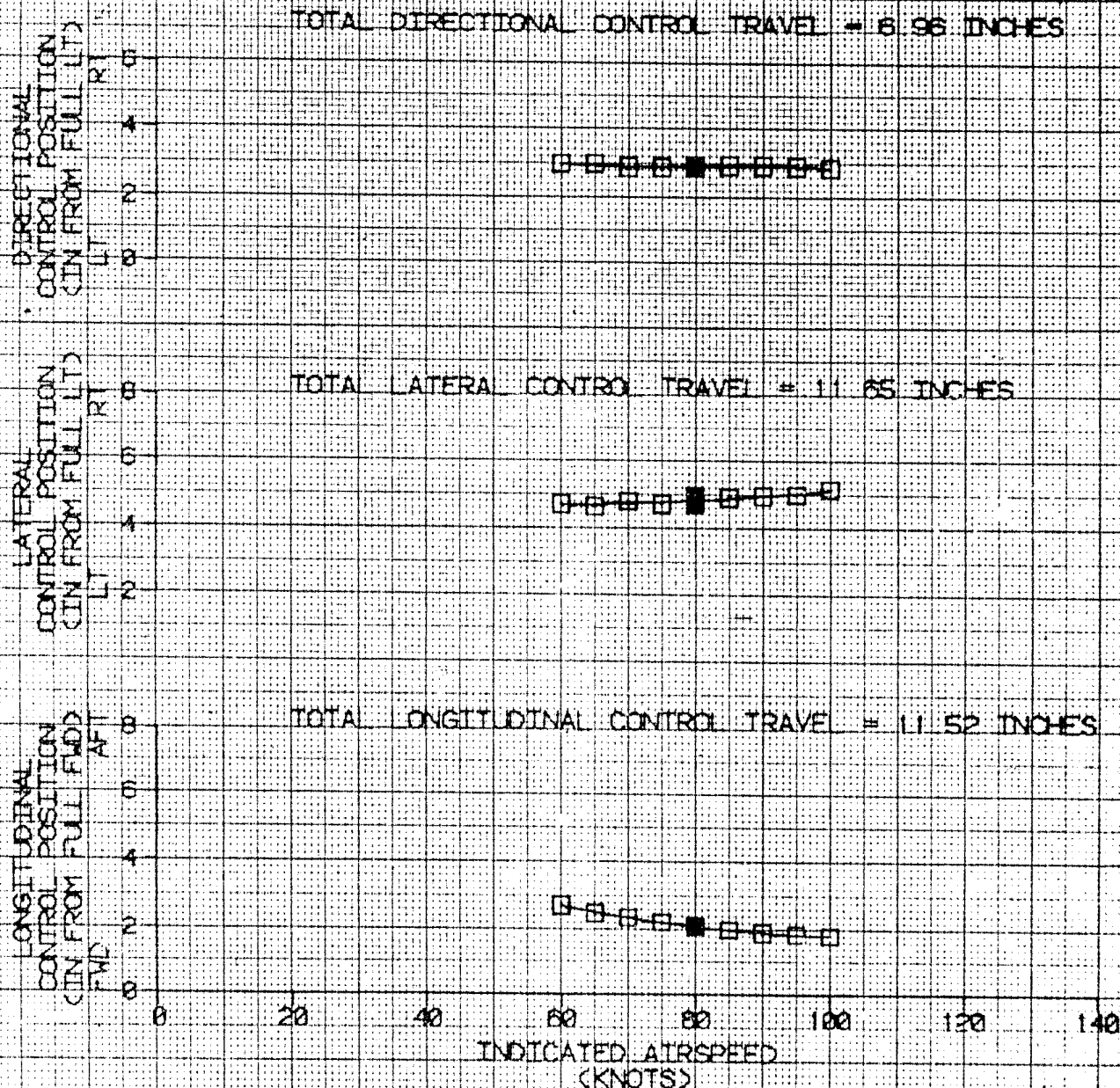


FIGURE 6
STATIC LONGITUDINAL STABILITY
UH-1H/HIND SURROGATE USA S/N 66-50928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG QAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|---------------------------|---------------------------------------|------------------------------|--------------------|--------------------------|-----------------------|
| 7528 | 137.5 (HIND) | 7020 | 13.0 | 324 | AUTO |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. FLASHMESS CONFIGURATION

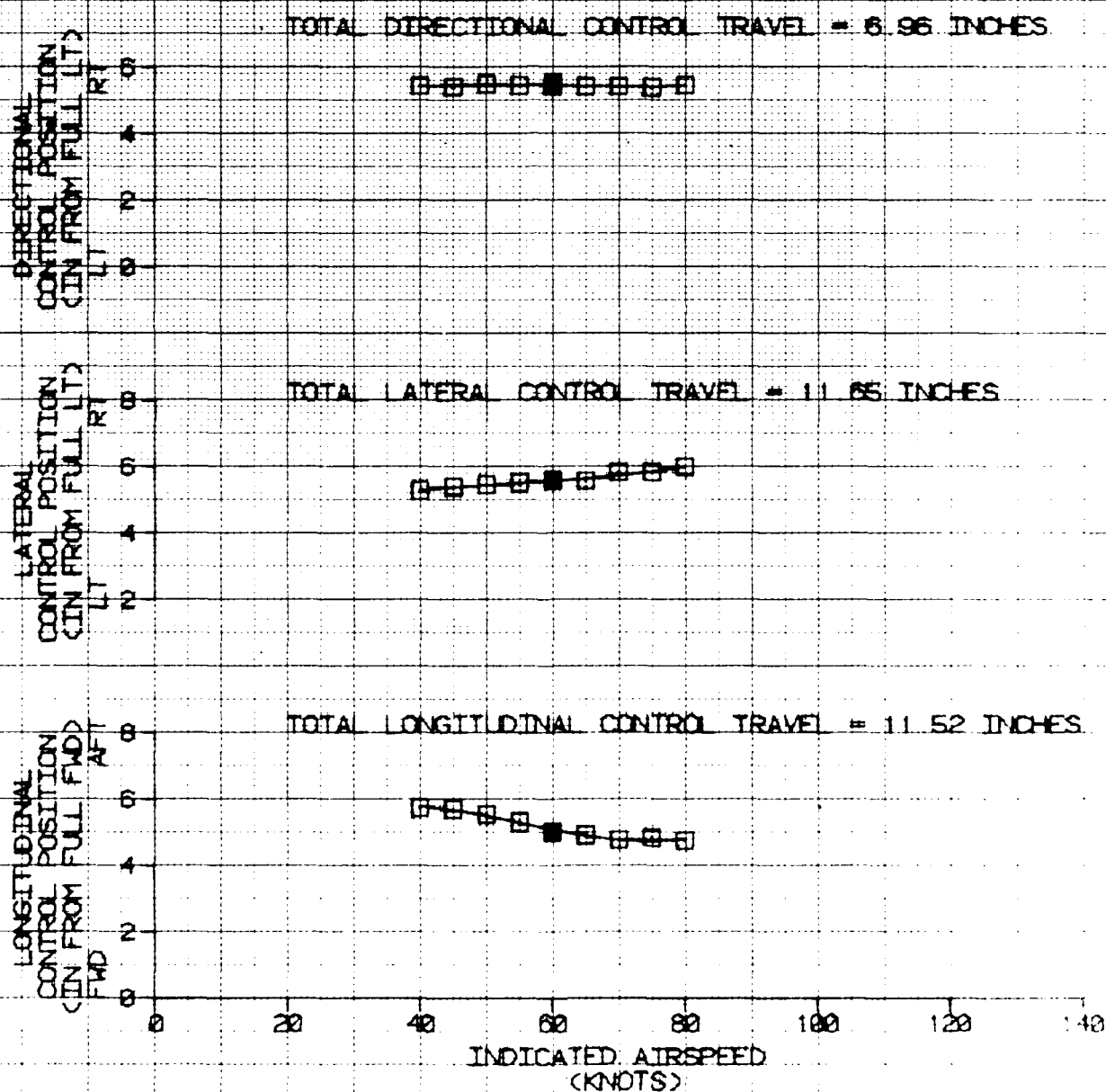


FIGURE 7

STATIC LONGITUDINAL STABILITY

UH-1H/HIND SURROGATE USA S/N 68-60928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSS) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM FLIGHT CONDITION |
|---------------------------------|---|------------------------------------|-----------------------|--------------------------------|-----------------------------|
| 7520 | 137.5 (MID) | 7020 | 13.0 | 324 | AUTO |

- NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. FLASHWESS CONFIGURATION

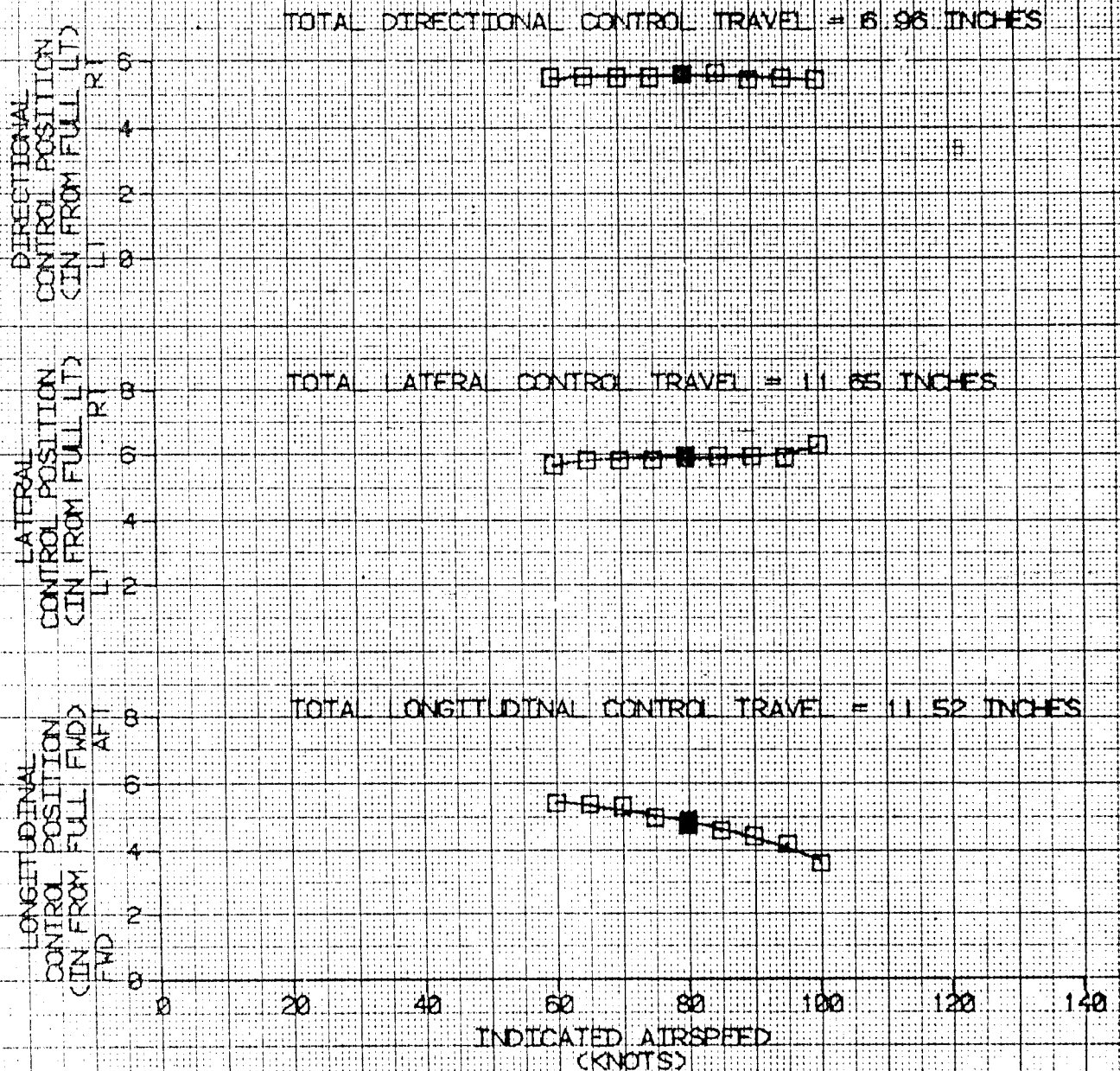


FIGURE 8
 STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 65-58928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG QAT (DES C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|------------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7528 | 137.5 (MID) | 7828 | 15.8 | 324 | 68 | LEVEL |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHNESS CONFIGURATION

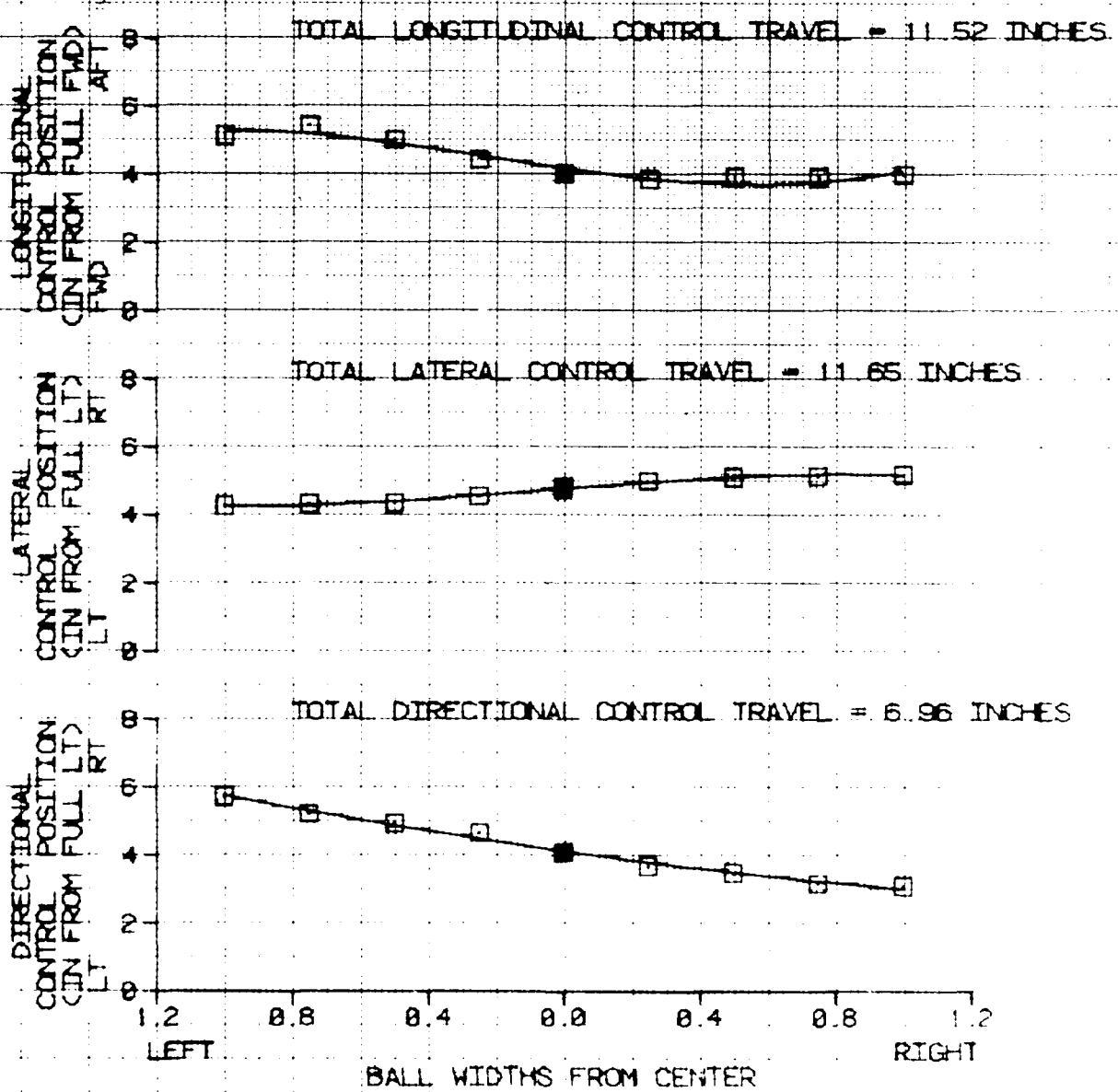


FIGURE 9
 STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 66-60928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FUS) (IN) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|------------------------|---|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.0 | 324 | 80 | LEVEL |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHLESS CONFIGURATION

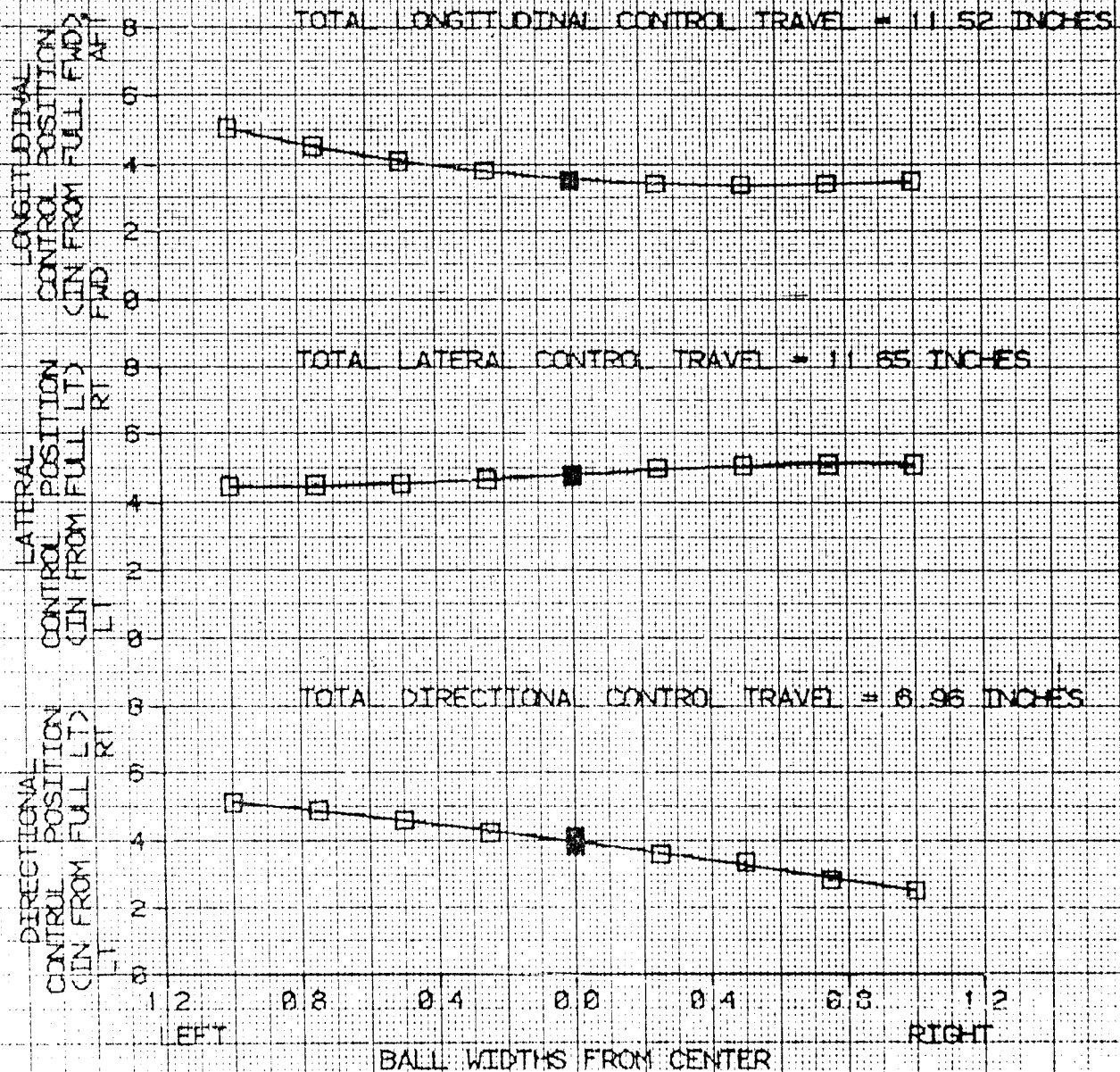


FIGURE 18
STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 65-80928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|-----------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.8 | 324 | 60 | CLIMB |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHWESS CONFIGURATION

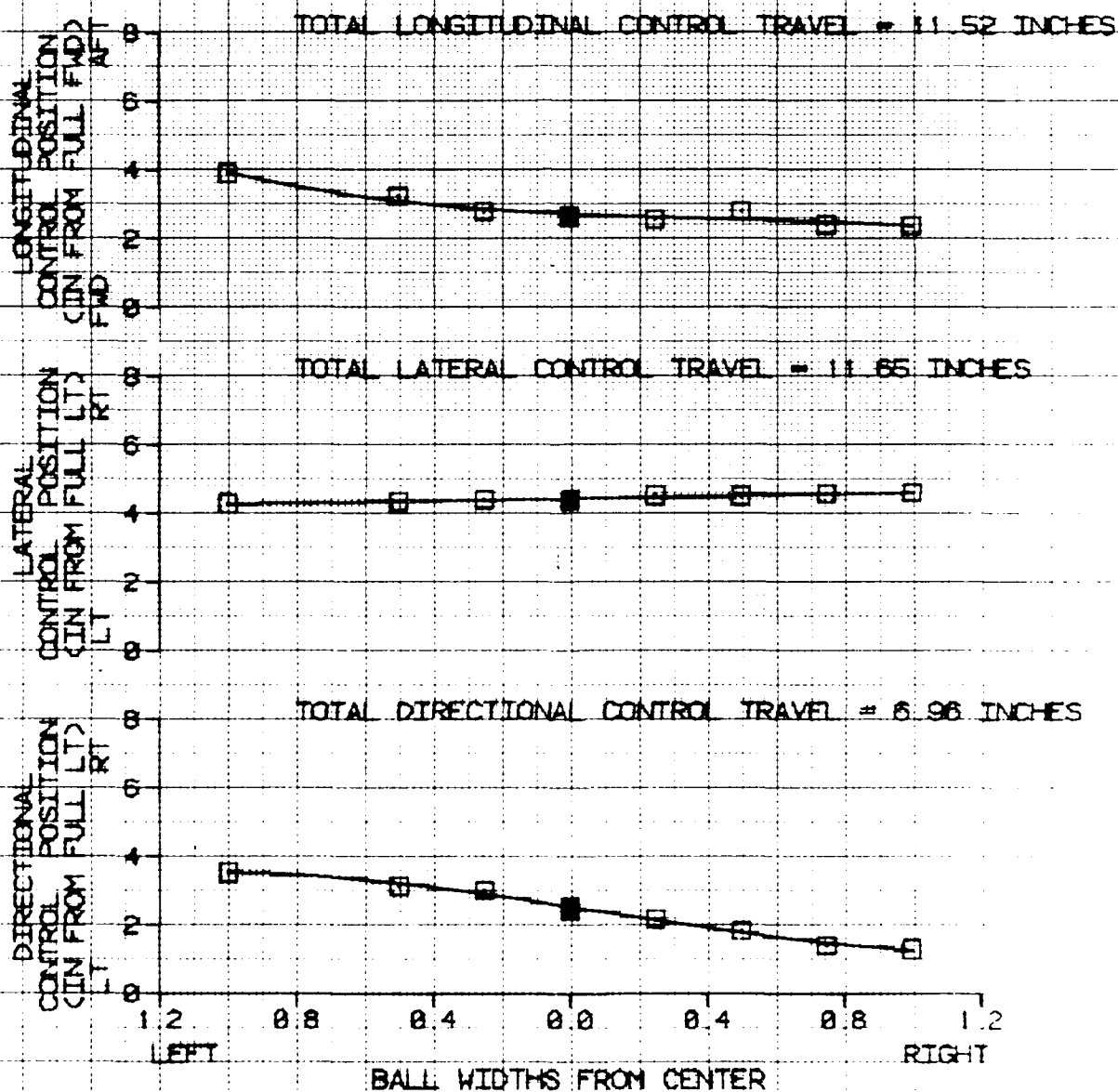


FIGURE 11
 STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/END SURROGATE USA S/N 66-60928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|-----------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7826 | 15.0 | 324 | 80 | CLIMB |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHWESS CONFIGURATION

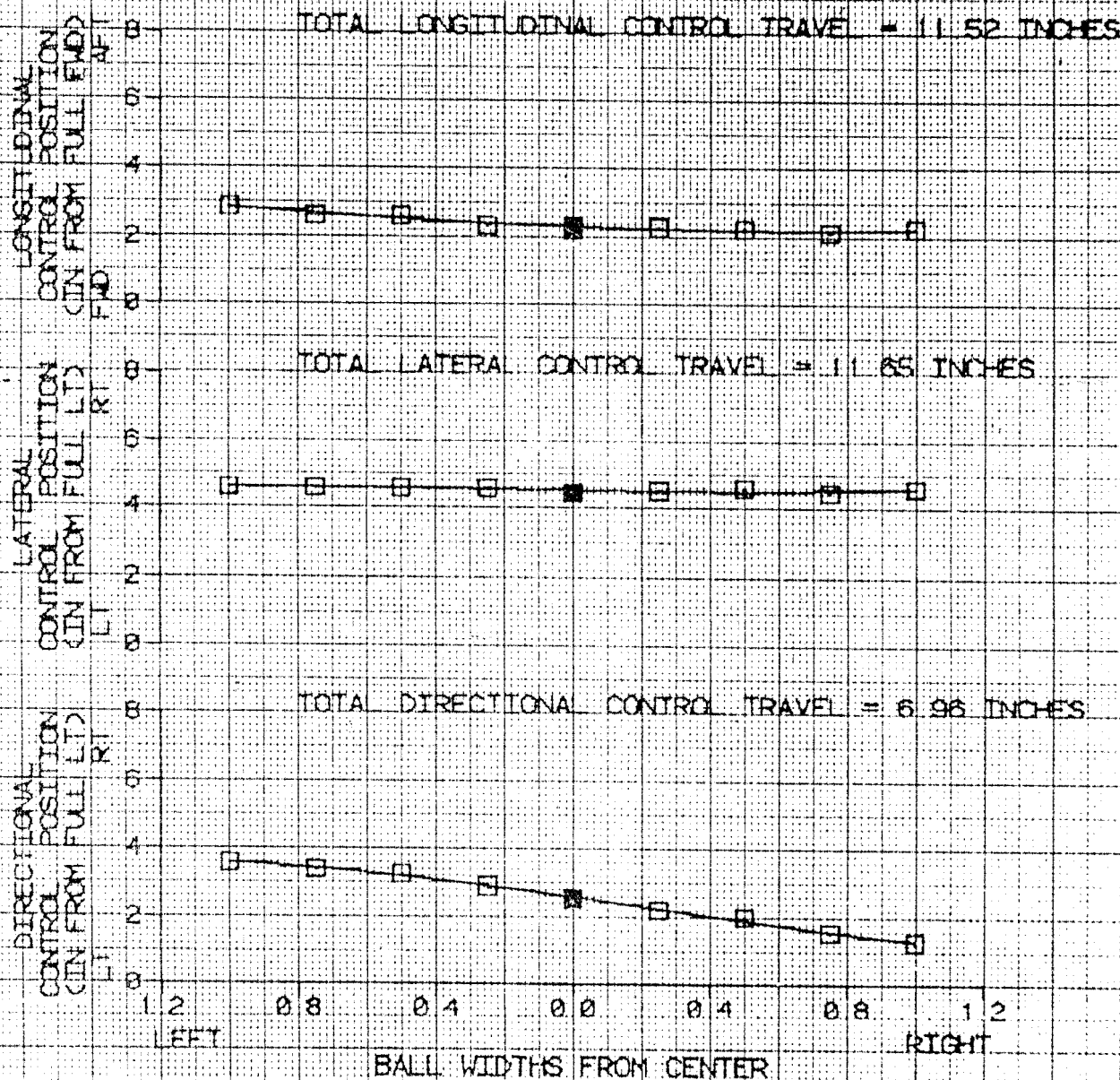


FIGURE 12
 STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 66-80928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|-----------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.0 | 324 | 60 | AUTO |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHWESS CONFIGURATION

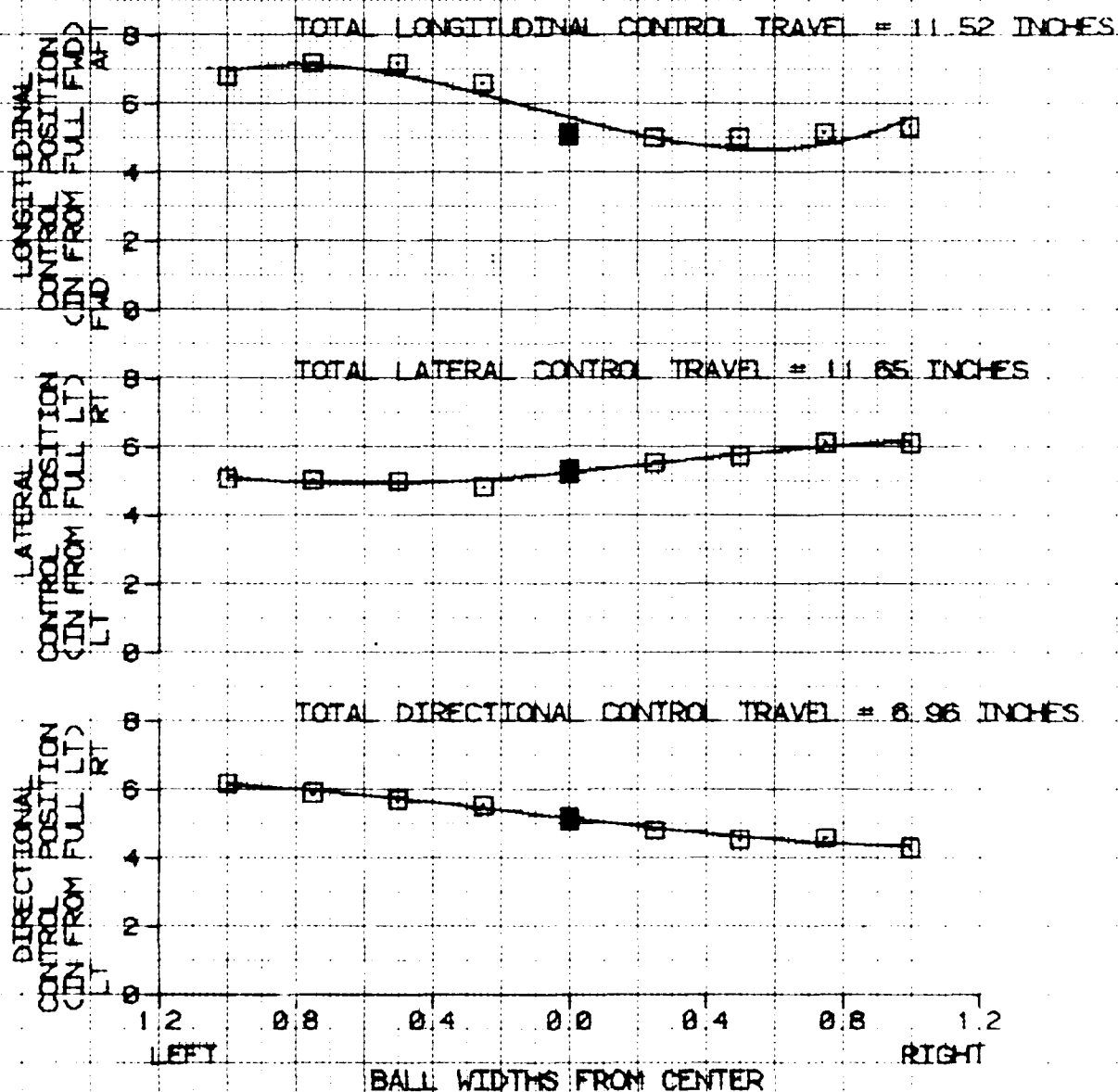


FIGURE 13
 STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 68-80928

| AVG GROSS WEIGHT (CLB) | AVG LONGITUDINAL CG LOCATION (CFS) | AVG DENSITY ALTITUDE (CFT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KTS) | TRIM FLIGHT CONDITION |
|------------------------|------------------------------------|----------------------------|-----------------|-----------------------|--------------------------------|-----------------------|
| 7520 | 137.8 (MID) | 7020 | 15.0 | 324 | 80 | AUTO |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. FLASHLESS CONFIGURATION

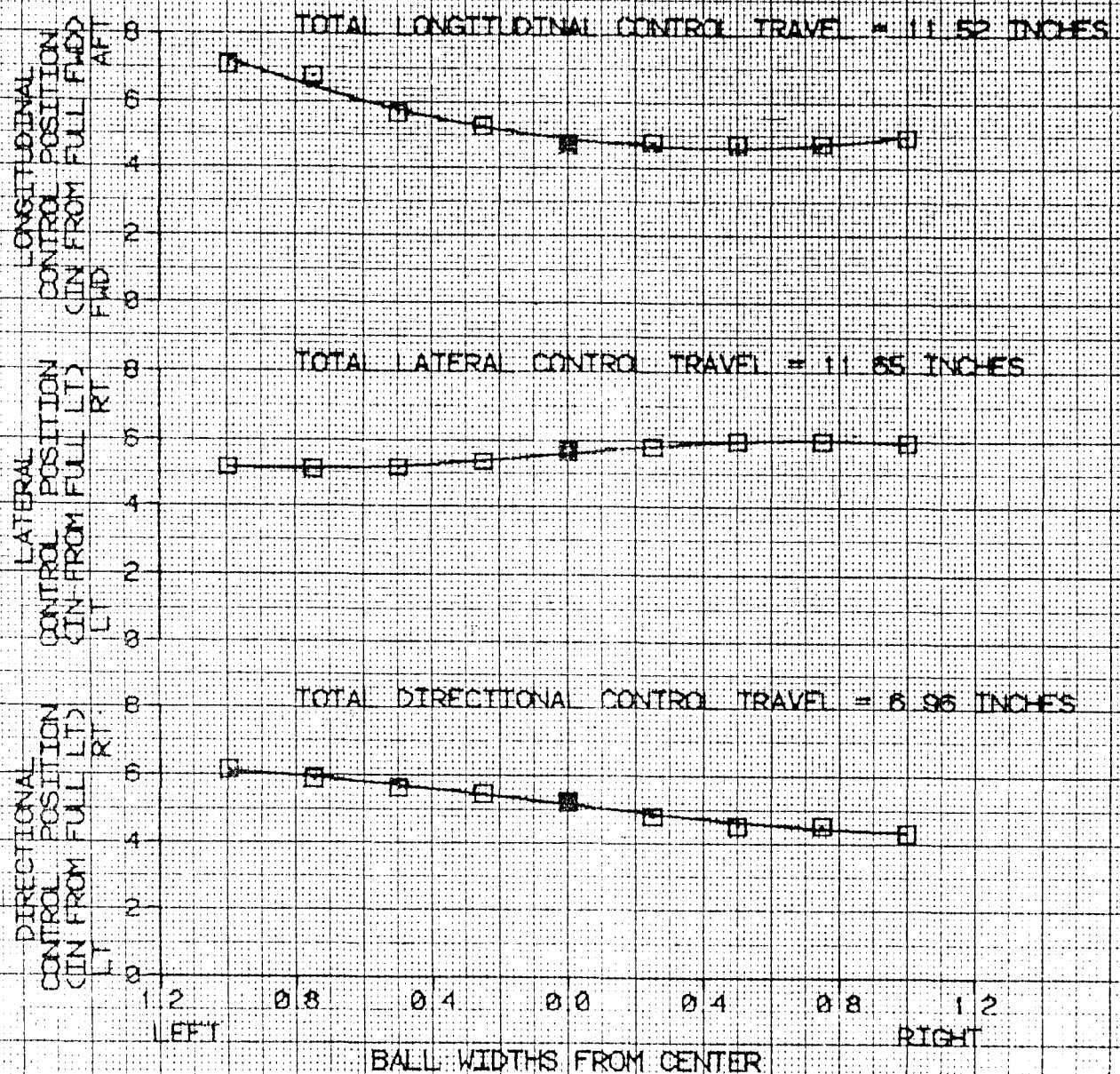


FIGURE 14
STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 65-50928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FUS) (IN) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|------------------------|---|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.0 | 324 | 80 | LEVEL |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. AWSS CONFIGURATION

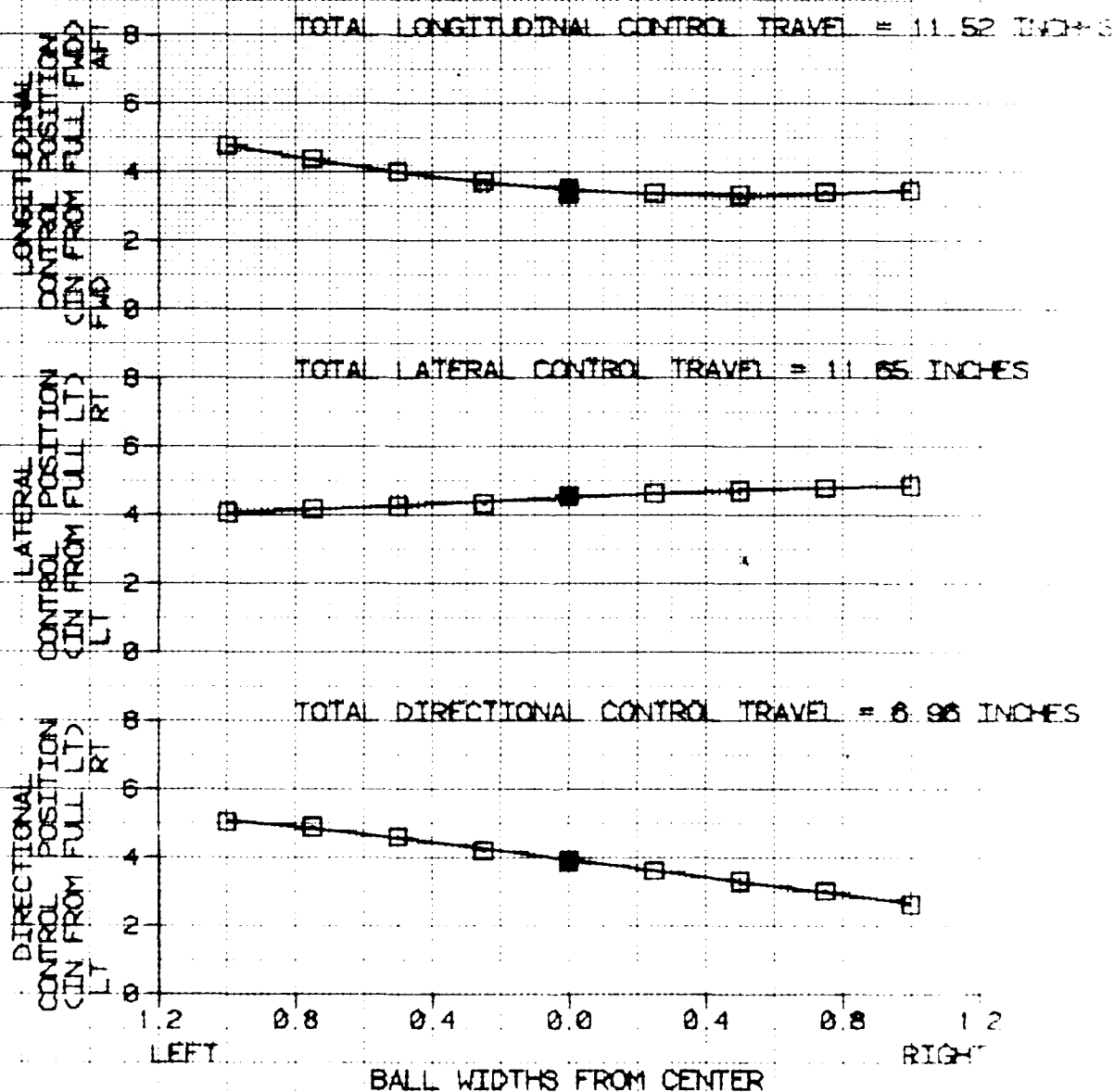


FIGURE 15

STATIC LATERAL-DIRECTIONAL STABILITY

UH-1H/HIND SURROGATE USA S/N 66-50928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|-----------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.0 | 324 | 80 | CLIMB |

- NOTES: 1. SHADED SYMBOLS DENOTE TRIM
2. AWSS CONFIGURATION

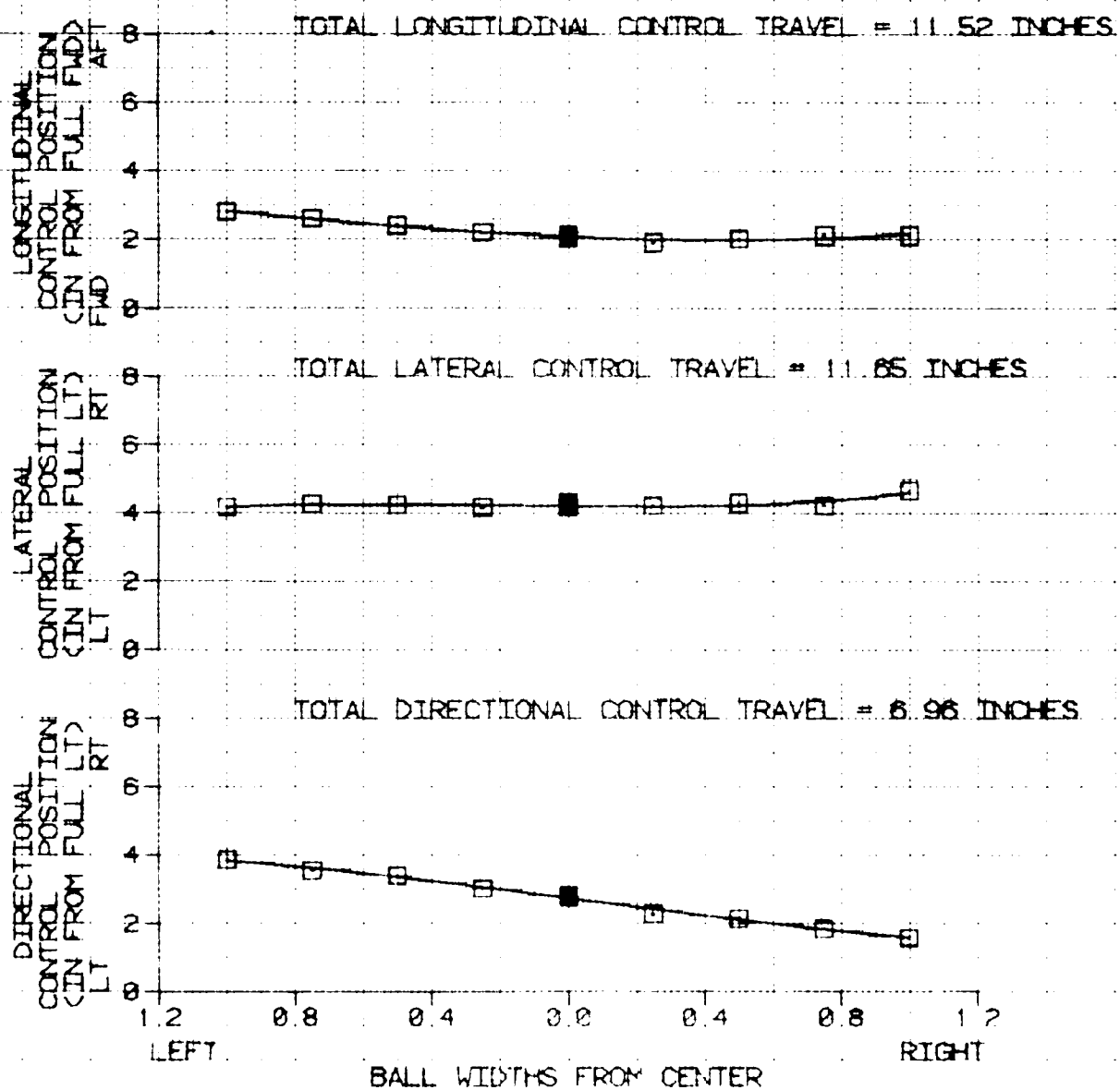


FIGURE 16
STATIC LATERAL-DIRECTIONAL STABILITY
 UH-1H/HIND SURROGATE USA S/N 65-60928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) | TRIM FLIGHT CONDITION |
|------------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|-----------------------|
| 7520 | 137.5 (MID) | 7020 | 15.0 | 324 | 80 | AUTO |

NOTES: 1. SHADED SYMBOLS DENOTE TRIM
 2. AWESS CONFIGURATION

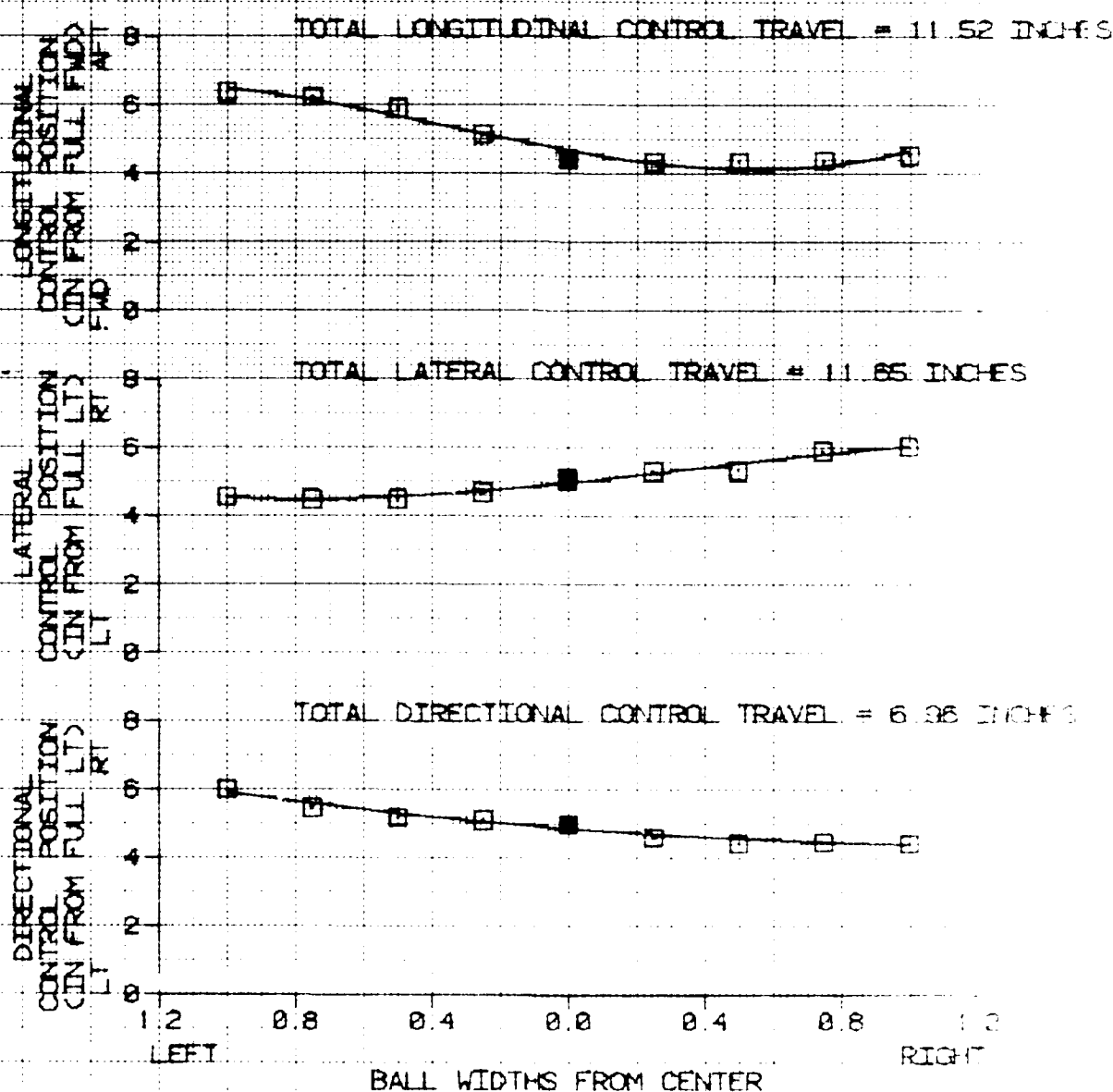


FIGURE 17
MANEUVERING STABILITY
UH-1H/HIND SURROGATE USA S/N 66-60828

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) |
|---------------------------------|---|------------------------------------|-----------------------|--------------------------------|--|
| 7870 | 137.5 (MID) | 7020 | 17.8 | 324 | 80 |

NOTES: 1. SQUARES DENOTE LEFT TURN
2. TRIANGLES DENOTE RIGHT TURN
3. FLASHWESS CONFIGURATION

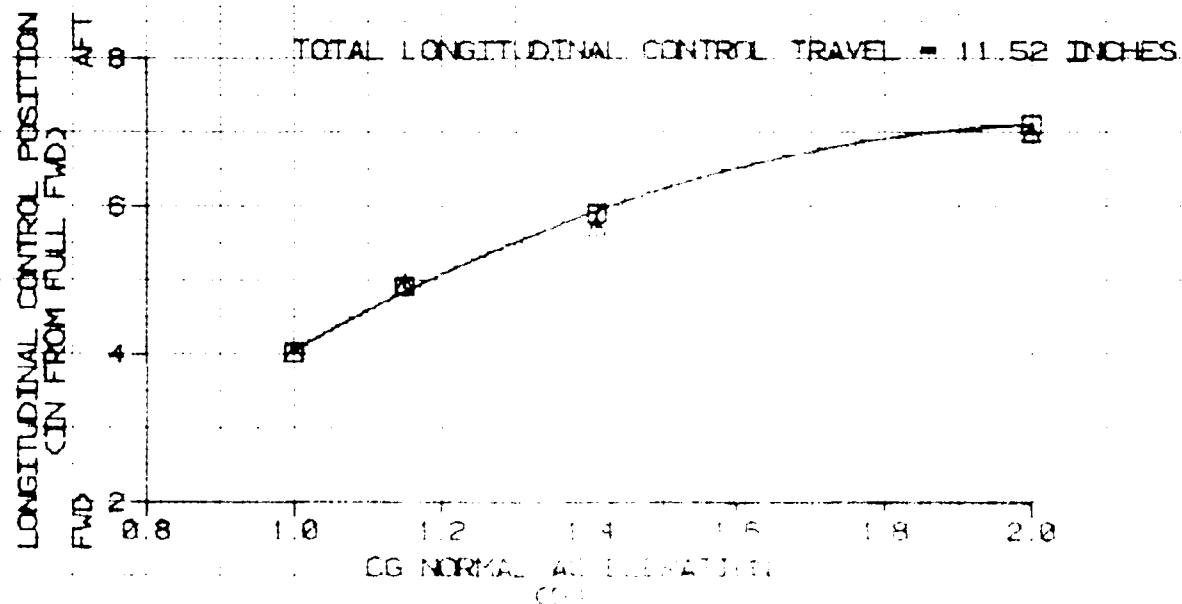
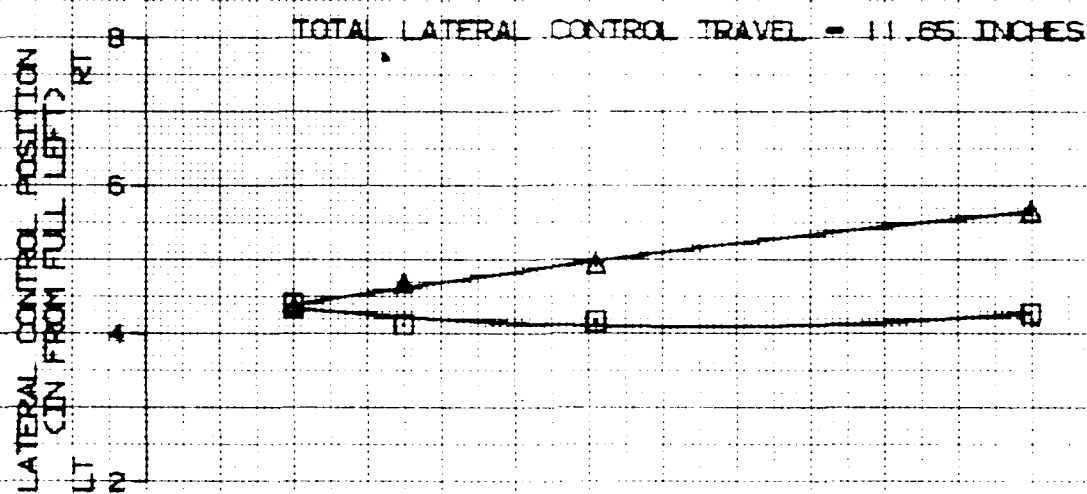


FIGURE 18
MANEUVERING STABILITY
UH-1H/HIND SURROGATE USA S/N 66-60928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FSD) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | TRIM CALIBRATED AIRSPEED (KT) |
|-----------------------|------------------------------------|---------------------------|-----------------|-----------------------|-------------------------------|
| 7670 | 137.5 (MID) | 7020 | 17.0 | 324 | 80 |

NOTES: 1. SQUARES DENOTE LEFT TURN
2. TRIANGLES DENOTE RIGHT TURN
3. FLASHMESS CONFIGURATION

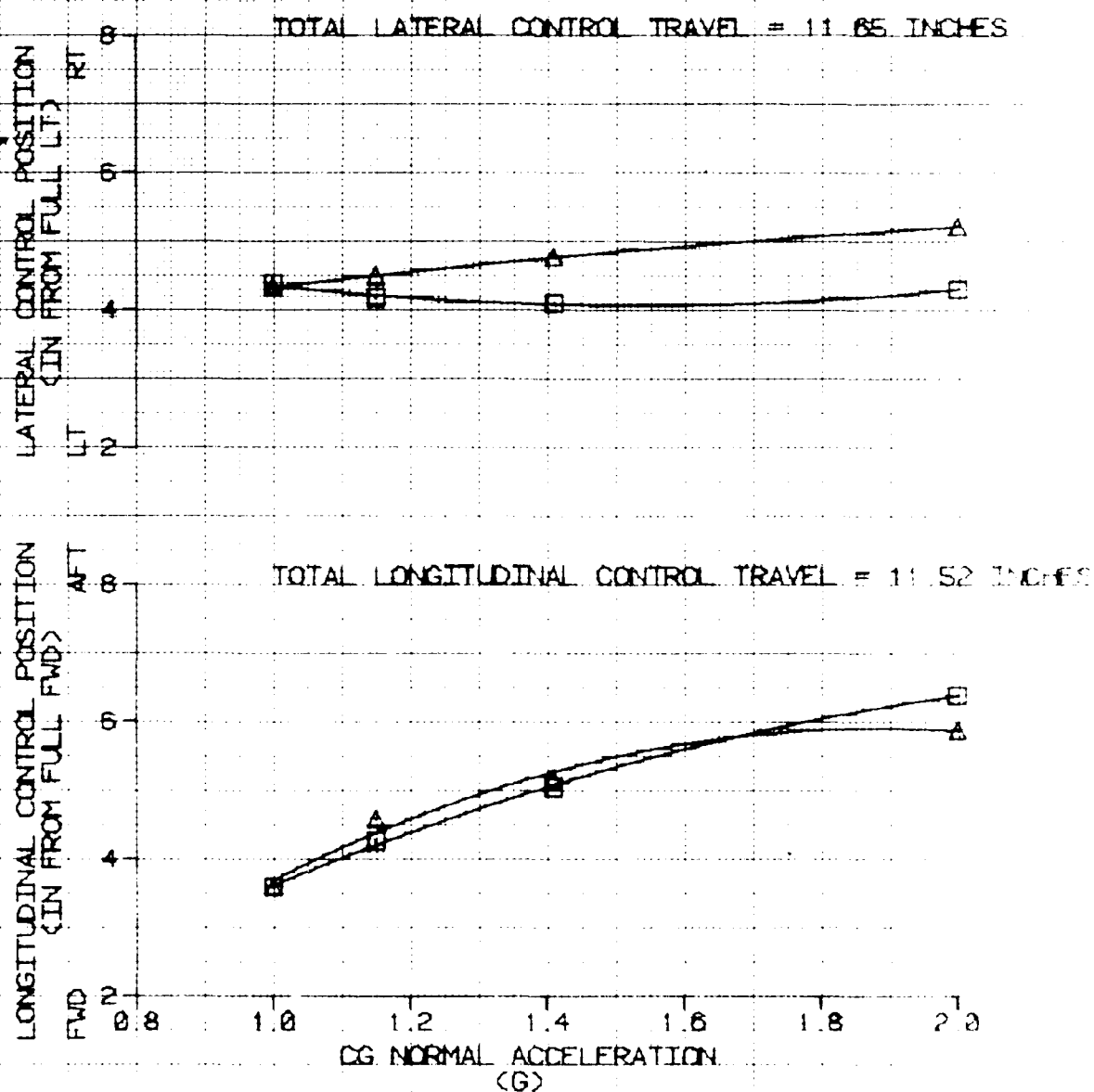


FIGURE 19
 LOW SPEED FORWARD AND REARWARD FLIGHT
 UH-1H/HIND SURROGATE USA S/N 66-60928

| AVG GROSS WEIGHT (LB) | AVG LONGITUDINAL CG LOCATION (FS) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | SKID HEIGHT (FT) |
|--------------------------------|--|------------------------------------|-----------------------|--------------------------------|------------------------|
| 7520 | 137.5 (MID) | 1980 | 10.0 | 324 | 10 |

NOTES: 1. FLASHMESS CONFIGURATION
 2. WINDS LESS THAN 5 KNOTS

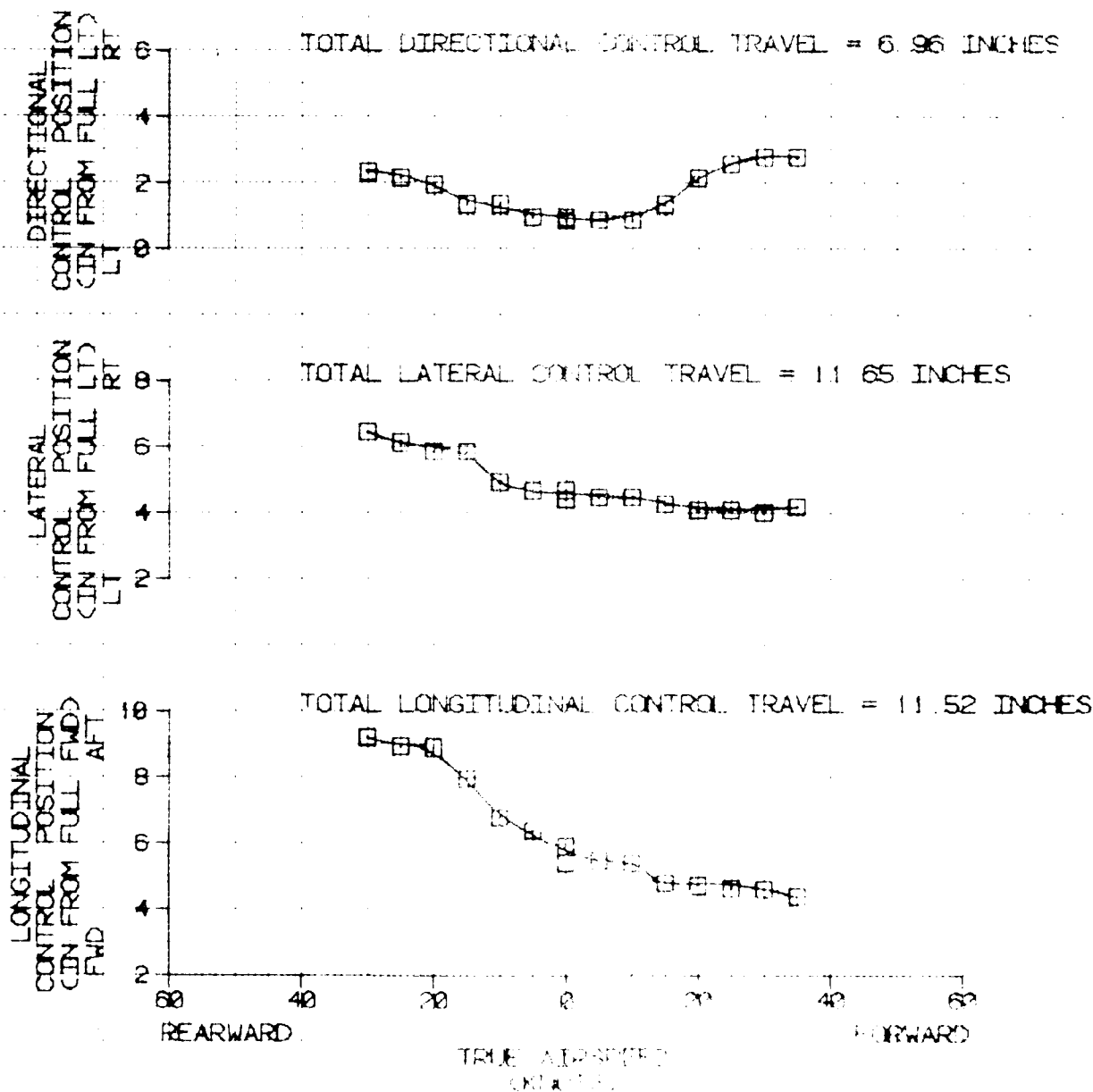


FIGURE 20 SIDEWARD FLIGHT

UH-1H/HIND SURROGATE USA S/N 66-80928

| AVG GROSS WEIGHT (LBS) | AVG LONGITUDINAL CG LOCATION (IFS) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | SKID HEIGHT (FT) |
|---------------------------------|---|------------------------------------|-----------------------|--------------------------------|------------------------|
| 7520 | 137.5 (HMD) | 1900 | 10.0 | 324 | 10 |

- NOTES: 1. FLASHLESS CONFIGURATION
2. WINDS LESS THAN 5 KNOTS

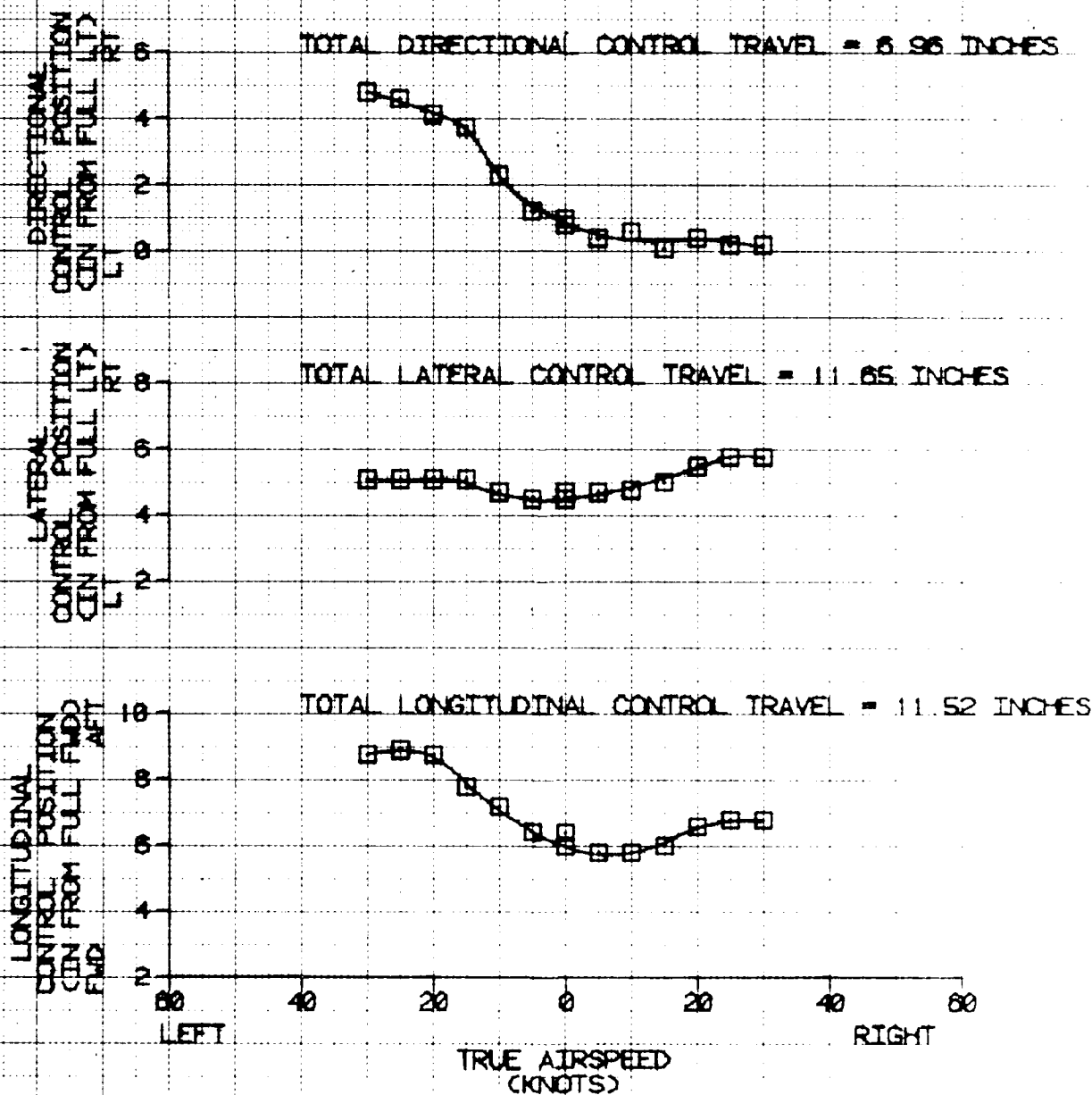


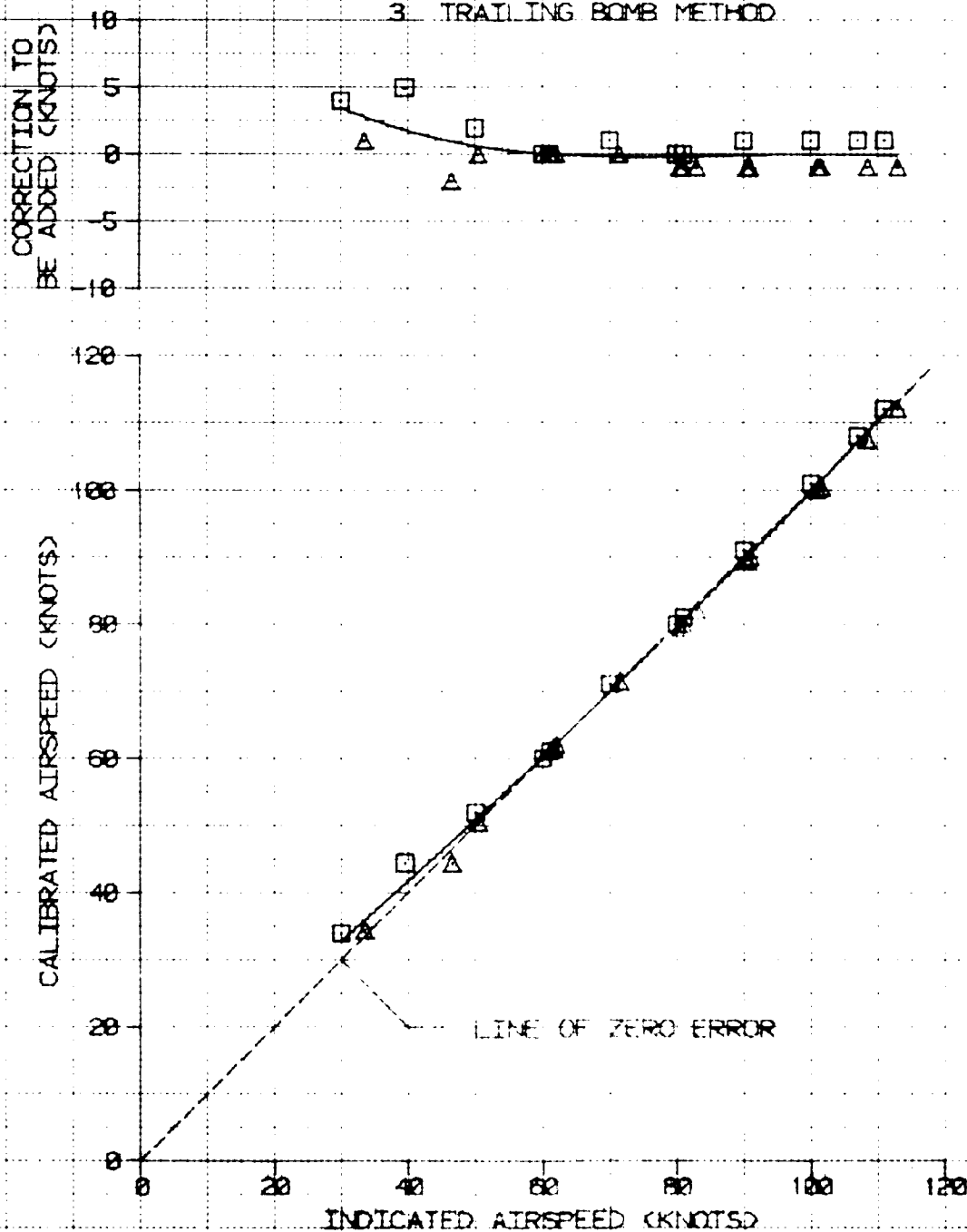
FIGURE 21

AIRSPEED CALIBRATION

UH-1H/HIND SURROGATE USA S/N 66-60928

| AVG GROSS WEIGHT (LB) | AVG CG LOCATION LONG (FS) | AVG CG LOCATION LAT (BL) | AVG DENSITY ALTITUDE (FT) | AVG OAT (DEG C) | AVG ROTOR SPEED (RPM) | FLIGHT CONDITION |
|-----------------------|---------------------------|--------------------------|---------------------------|-----------------|-----------------------|------------------|
| 7690 | 137.5(MID) | 0.0 | 7020 | 12.0 | 324 | LEVEL |

- NOTES: 1. SQUARES DENOTE PILOT INDICATOR
 2. TRIANGLES DENOTE COPILOT INDICATOR
 3. TRAILING BOMB METHOD



APPENDIX D. PHOTOGRAPHS

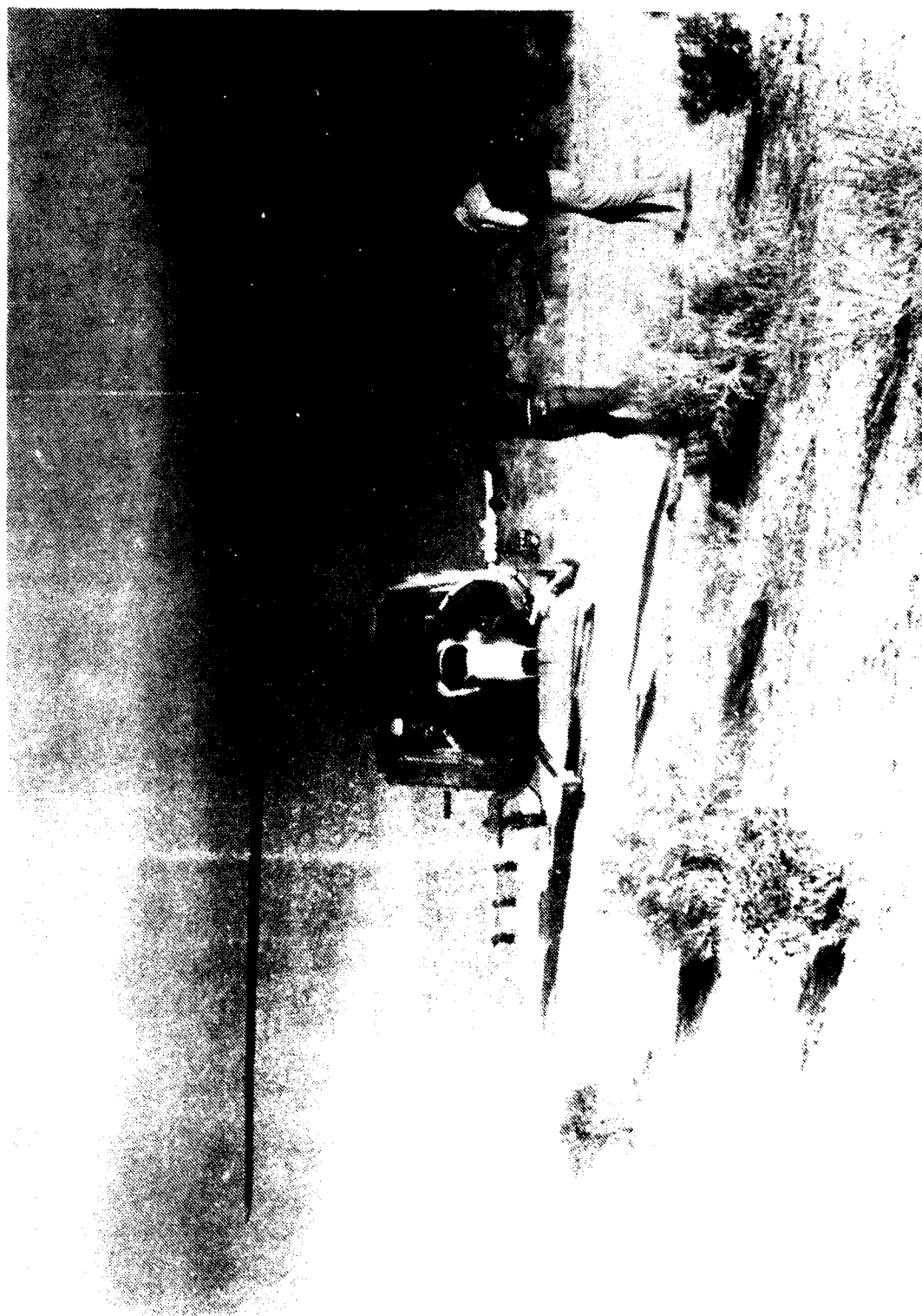


Photo 1. UH-1H/HIND-D Surrogate - Slope Landing

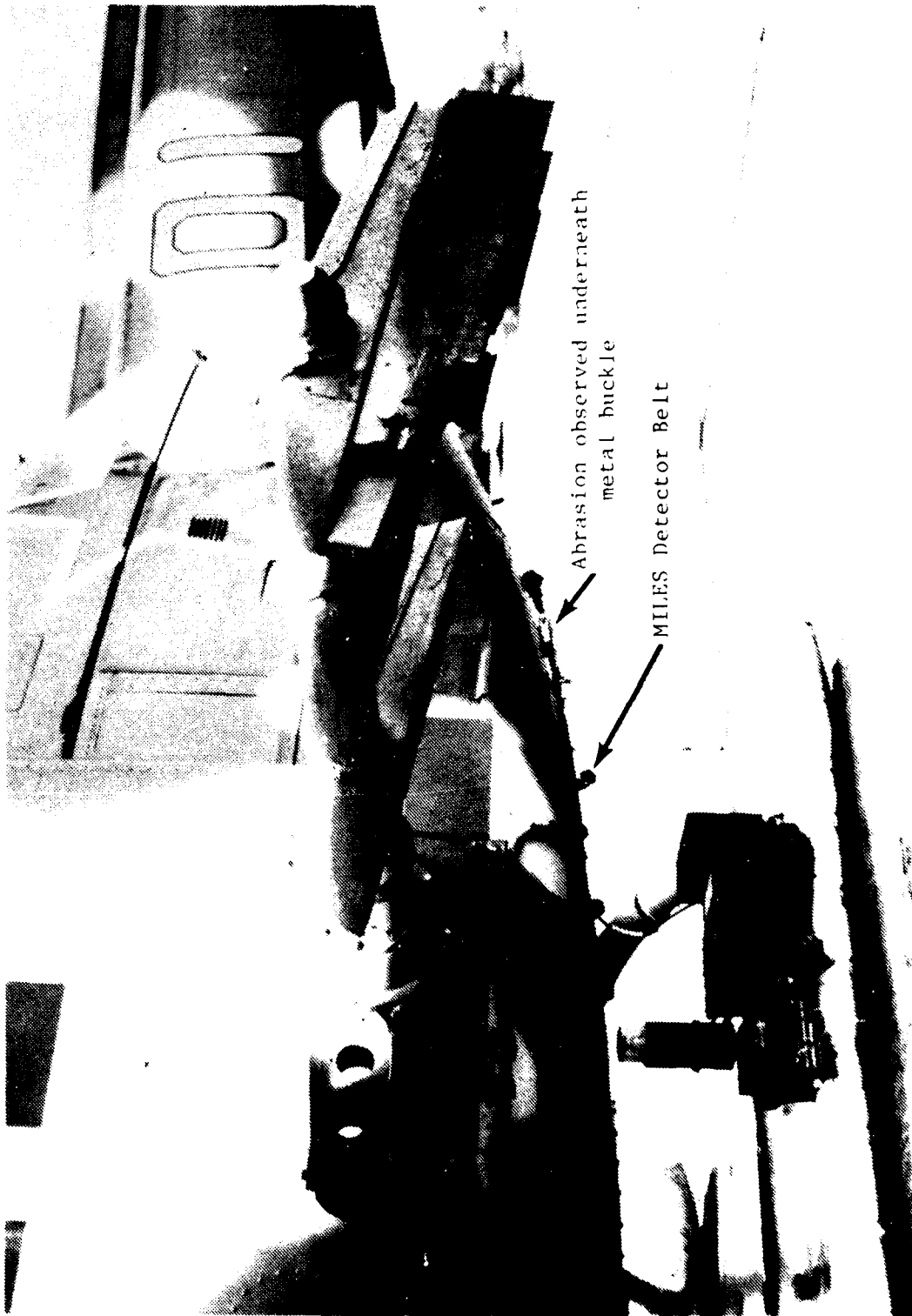


Photo 2. UH-1H/HIND-D Surrogate - Left Side

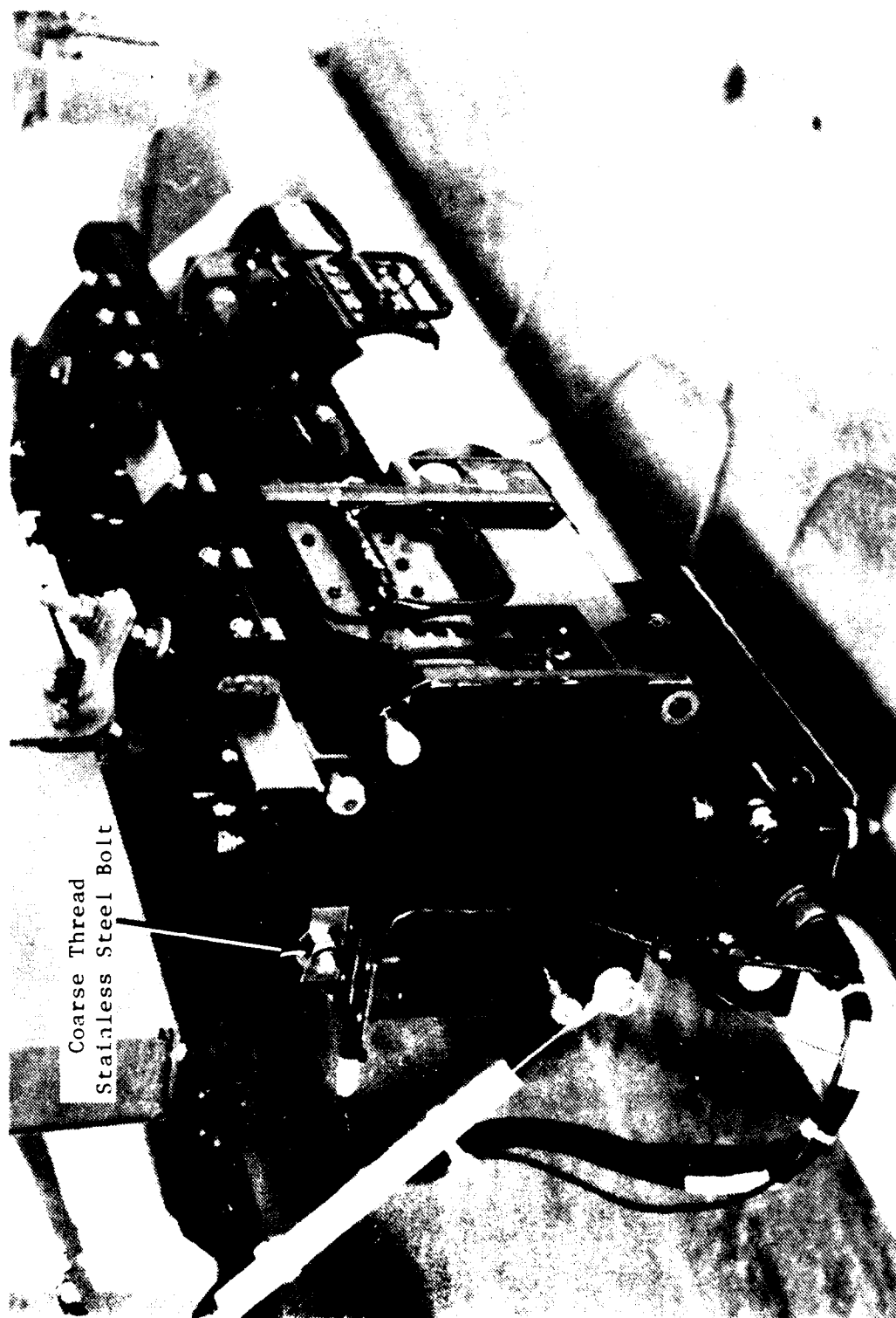


Photo 3. AWESS Assembly - Aft View

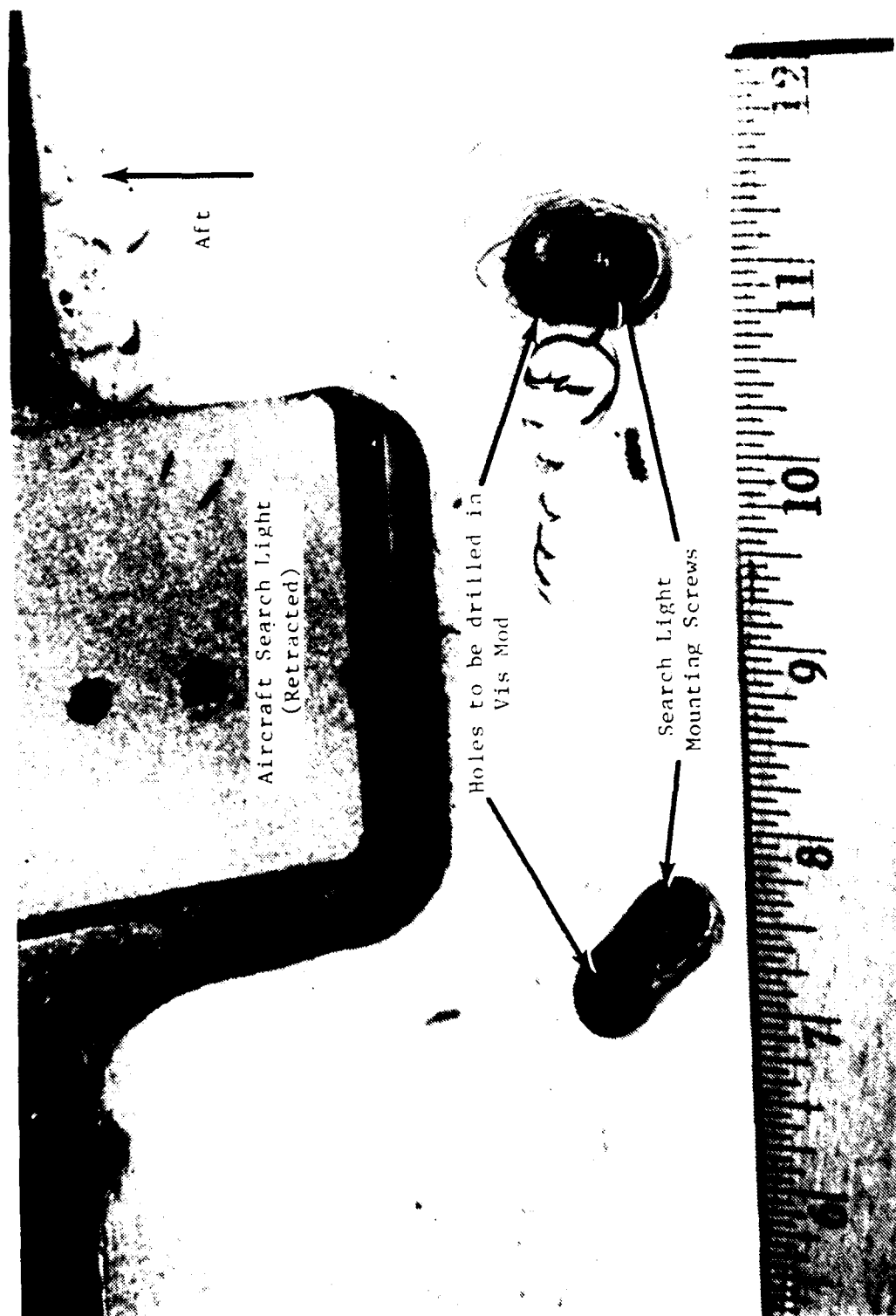


Photo 4. Bottom View - Vis Mod

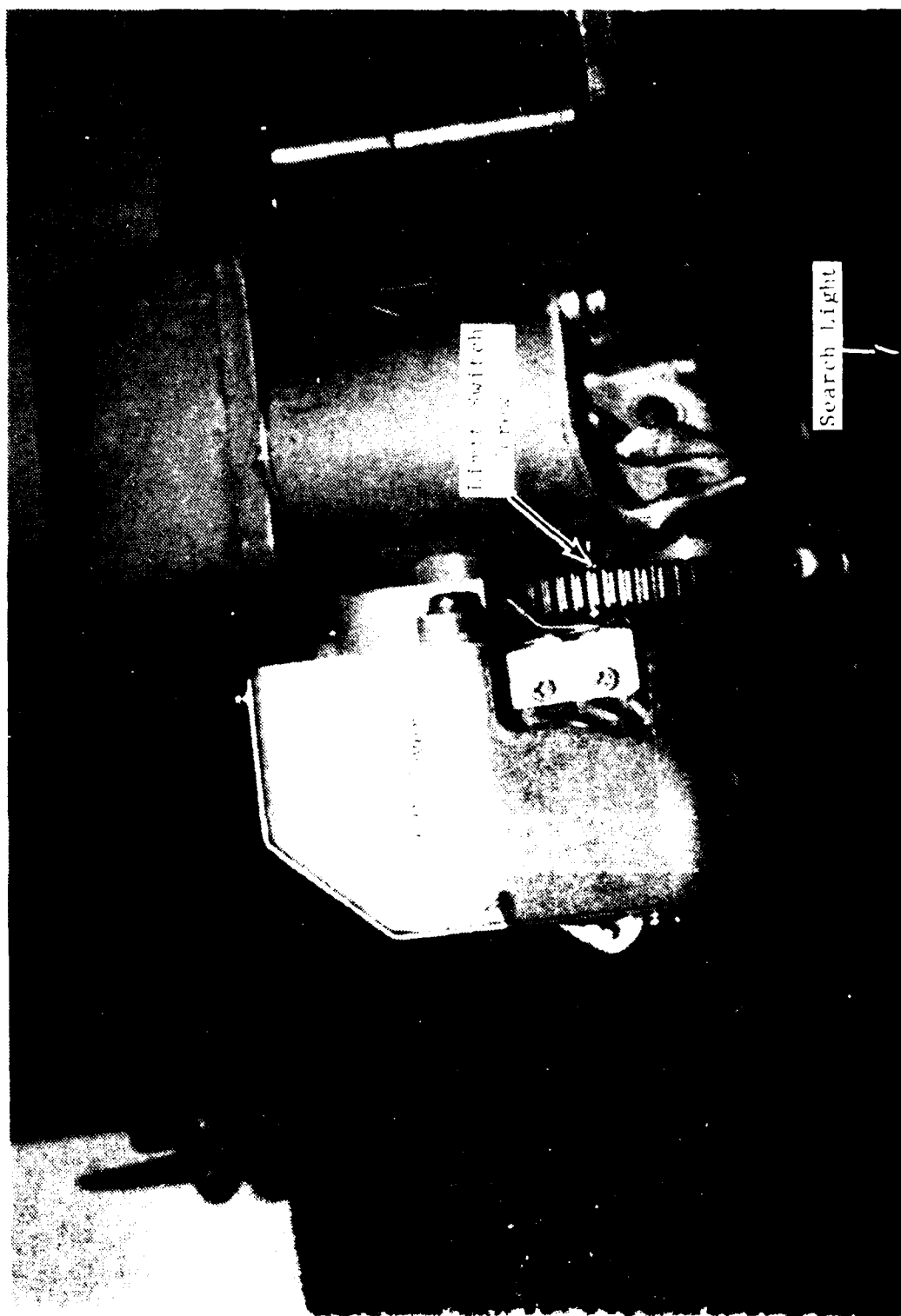


Photo 5. Search Light Assembly - Removed from Aircraft

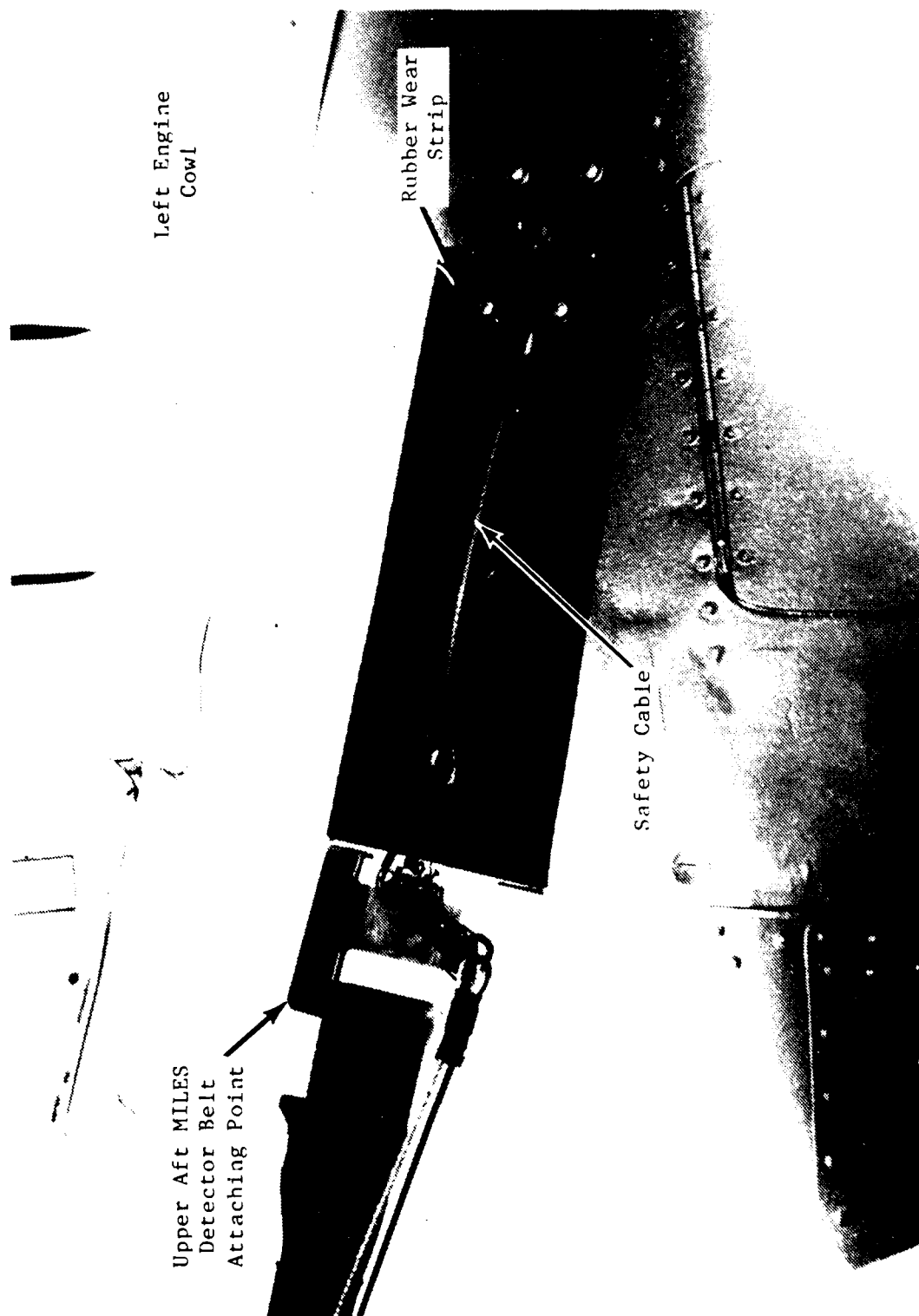


Photo 6. UH-1H/HIND-D Surrogate - Upper Aft Left Fuselage

DISTRIBUTION

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| HQDA (DALO-AV, DALO-FDQ, DAMO-HRS, DAMA-PPM-T, DAMA-RA, DAMA-WSA) | 6 |
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| US Army Combined Arms Center (ATZL-TIE) | 1 |
| US Army Safety Center (PESC-SPA, PESC-SE) | 2 |
| US Army Cost and Economic Analysis Center (CACC-AM) | 1 |
| US Army Aviation Research and Technology Activity (AVSCOM) NASA/Ames Research Center (SAVRT-R, SAVRT-M (Library)) | 3 |
| US Army Aviation Research and Technology Activity (AVSCOM) Aviation Applied Technology Directorate (SAVRT-TY-DRD SAVRT-TY-TSC (Tech Library)) | 2 |

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| US Army Aviation Research and Technology Activity (AVSCOM) | 1 |
| Aeroflightdynamics Directorate (SAVRT-AF-D) | |
| US Army Aviation Research and Technology Activity (AVSCOM) | 1 |
| Propulsion Directorate (SAVRT-PN-D) | |
| Defense Technical Information Center (FDAC) | 2 |
| US Military Academy, Department of Mechanics | 1 |
| (Aero Group Director) | |
| ASD/AFXT, ASD/ENF | 2 |
| US Army Aviation Development Test Activity (STEBG-CT) | 2 |
| Assistant Technical Director for Projects, Code: CT-24 | |
| (Mr. Joseph Dunn) | 2 |
| 6520 Test Group (ENML) | 1 |
| Commander, Naval Air Systems Command (AIR 5115B, AIR 5301) | 3 |
| Defense Intelligence Agency (DIA-DT-2D) | 1 |
| Commander, NTC Flight Detachment (CW3 William Butts) | 2 |
| Commander, US Army TRADOC (ATIC-NC) | 2 |